

55-1520-235-10

TM 55-1520-235-10

TECHNICAL MANUAL

OPERATORS MANUAL

ARMY OH-58C HELICOPTER

This copy is a reprint which includes current
pages from Changes 1 through 41.

HEADQUARTERS, DEPARTMENT OF THE ARMY

7 APRIL 1978

READER
FICHE best copy available

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CHANGE }
NO. 41 }

TM 55-1520-235-10
C 41

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WASHINGTON, D.C., 27 March 1987

Operator's Manual
ARMY MODEL OH-58C HELICOPTER

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Remove pages

2-3 and 2-4
2-9 and 2-10

8-3 through 8-8
8-8.1/8-8.2
8-11 and 8-12

Insert pages

2-3 and 2-4
2-9 and 2-10
2-28.1/2-28.2
8-3 through 8-8
8-8.1/8-8.2
8-11 and 8-12

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Remove pages

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8-11 and 8-12

Insert pages

8-7 and 8-8
8-11 and 8-12

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Remove pages

2-3 and 2-4
2-7 through 2-10
2-23 through 2-26
- - -
2-27 through 2-30
3-7 and 3-8
3-27/3-28
8-3 through 8-8
8-8.1/8-8.2
8-11 through 8-14

Insert pages

2-3 and 2-4
2-7 through 2-10
2-23 through 2-26
2-26.1/2-26.2
2-27 through 2-30
3-7 and 3-8
3-27/3-28
8-3 through 8-8
8-8.1/8-8.2
8-11 through 8-14

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ARMY MODEL OH-58C HELICOPTER

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Chapter 7	7-23 and 7-24	7-23 and 7-24
Chapter 9	9-9 thru 9-10.1/9-10.2	9-9 thru 9-10.1/9-10.2

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Chapter 5	5-7 and 5-8 5-11 and 5-12	5-7 and 5-8 5-11/5-12
Chapter 7	7-19 and 7-20 7-23 and 7-24	7-19 and 7-20 7-23 and 7-24
Chapter 8	8-17 thru 8-18.2	8-17 thru 8-18.4
Chapter 9	9-9 and 9-10	9-9 and 9-10

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Chapter 2	2-13 and 2-14	2-13 and 2-14 2-14.1/2-14.2
Chapter 8	8-5 and 8-6 8-11 and 8-12	8-5 and 8-6 8-11 and 8-12
Chapter 9	9-9 and 9-10 9-10.1/9-10.2 9-13/9-14	9-9 and 9-10 9-10.1/9-10.2 9-13/9-14

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	Remove Pages	Insert Pages
Chapter 5	5-7 and 5-8	5-7 and 5-8
	5-11 and 5-12	5-11 and 5-12
Chapter 8	8-7 thru 8-14.1/8-14.2	8-7 thru 8-14

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	Remove Pages	Insert Pages
Warning	a and b	a and b
Table of Contents	i and ii	i and ii
Chapter 2	2-1 thru 2-4	2-1 thru 2-4.1/2-4.2
	2-5 thru 2-8	2-5 thru 2-8
	2-15 and 2-16	2-15 and 2-16
	2-19 thru 2-20.2	2-19 thru 2-20.2
	2-27 thru 2-34	2-27 thru 2-34
	---	2-36.1/2-36.2
	2-39 and 2-40	2-39 and 2-40
Chapter 3	3-1 thru 3-4	3-1 thru 3-4
	3-15 and 3-16	3-15 and 3-16
	3-21 and 3-22	3-21 and 3-22
Chapter 5	5-1 thru 5-6	5-1 thru 5-6
	5-8.1 and 5-8.2	5-8.1 and 5-8.2
Chapter 6	6-1 thru 6-11/6-12	6-1 thru 6-11/6-12
Chapter 7	7-1 and 7-2	7-1 and 7-2
	7-5 thru 7-7/7-8	7-5
	7-19 and 7-20	7-19 and 7-20
	7-23 and 7-24	7-23 and 7-24
	7-33 and 7-34	7-33 and 7-34
	7-45/7-46	7-45/7-46
Chapter 8	8-1 and 8-2	8-1 and 8-2
	8-5 and 8-6	8-5 and 8-6
	8-15 and 8-16	8-15 and 8-16
	8-19 thru 8-22	8-19 thru 8-22
Chapter 9	9-1 thru 9-13/9-14	9-1 thru 9-13/9-14
Appendix A	A-1/A-2	A-1/A-2

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Chapter 8	8-17 thru 8-18.2	8-17 thru 8-18.2
Chapter 9	9-9 and 9-10	9-9 and 9-10

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Chapter 2	2-20.1/2-20.2 2-21 and 2-22	2-20.1 and 2-20.2 2-21 and 2-22
Chapter 5	5-7 thru 5-8.2 5-11 and 5-12	5-7 thru 5-8.3/5-8.4 5-11 and 5-12

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Operator's Manual

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Change 24 will be forthcoming. TM changes must be inserted in numerical sequence.

TM 55-1520-235-10
C 25

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NO. 25 }

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Chapter 2	2-1 and 2-2 2-25 and 2-26	2-1 and 2-2 2-25 and 2-26
Chapter 5	5-5 and 5-6	5-5 and 5-6
Chapter 9	9-7 and 9-8	9-7 and 9-8

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Chapter 2	2-3 and 2-4 2-11 and 2-12 2-15 thru 2-18 2-21 and 2-22 2-27 thru 2-30 2-39 and 2-40	2-3 and 2-4 2-11 thru 2-12.1/2-12.2 2-15 thru 2-18 2-21 and 2-22 2-27 thru 2-30 2-39 and 2-40
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Chapter 5	5-1 and 5-2 5-8.1 thru 5-10	5-1 and 5-2 5-8.1 thru 5-10
Chapter 6	6-1 thru 6-4.2 6-11/6-12	6-1 thru 6-4.2 6-11/6-12
Chapter 7	7-9 and 7-10 7-23 and 7-24	7-9 and 7-10 7-23 and 7-24
Chapter 8	8-3 thru 8-14 8-17 and 8-18	8-3 thru 8-14.1/8-14.2 8-17 thru 8-18.2
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Operator's Manual

ARMY MODEL OH-58C HELICOPTER

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Chapter 5	5-3 5-5 and 5-6	5-3 5-5 and 5-6
Chapter 9	9-11 and 9-12 9-13/9-14	9-11 thru 9-12.1/9-12.2 9-13/9-14

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Operator's Manual

ARMY MODEL OH-58C HELICOPTER

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Chapter 5	5-3	5-3
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WARNING

Personnel performing operations, procedures and practices which are included or implied in this technical manual shall observe the following warnings. Disregard of these warnings and precautionary information can cause serious injury or loss of life.

START ENGINE

Coordinate all cockpit actions with ground observer. Insure that rotors and blast areas are clear and fire guard is posted.

FIRE EXTINGUISHER

Exposure to high concentrations of monobromotrifluoromethane (CF₃Br) extinguishing agent or toxic fumes produced by the agent should be avoided. The liquid should not be allowed to come into contact with the skin, as it may cause frostbite or low temperature burns.

GROUND OPERATION

Engines will be started and operated only by authorized personnel. Reference AR 95-1.

ELECTROLYTE

Battery electrolyte is harmful to the skin and clothing. Neutralize any spilled electrolyte by flushing contacted areas thoroughly with water.

CARBON MONOXIDE

When smoke, suspected carbon monoxide fumes, or symptoms of anoxia exist, the crew should immediately ventilate cabin and shut off heater.

HANDLING FUEL AND OILS

Turbine fuels and lubricating oil contain additives which are poisonous and readily absorbed through the skin. Do not allow them to remain on skin longer than necessary.

HANDLING HYDRAULIC FLUID (MIL-H-83282)

Prolonged contact with liquid or mist can irritate eyes and skin. After any prolonged contact with skin, immediately wash contacted area with soap and water. If liquid contacts eyes, flush immediately with clear water. If liquid is swallowed, do not induce vomiting; get immediate medical attention. Wear rubber gloves when handling liquid. If prolonged contact with mist is likely, wear an appropriate respirator. When fluid is decomposed by heating, toxic gases are released.

HAZARDOUS CARGO

Items of cargo possessing dangerous physical properties, such as explosives, acids, flammables, etc., must be handled with extreme caution and in accordance with established regulations. Refer to TM 38-250.

NOISE

Sound pressure levels in this aircraft during some operating conditions exceed the Surgeon General's hearing conservation criteria as defined in TB MED 501. Hearing protection devices, such as the aviator helmet or ear plugs are required to be worn by all personnel in and around the aircraft during its operation.

TECHNICAL MANUAL

No. 55-1520-235-10

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 7 April 1978

Operator's Manual

HELICOPTER, OBSERVATION

OH-58C

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistake or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, US Army Troop Support & Aviation Materiel Readiness Command, ATTN: DRSTS-MPSD, 4300 Goodfellow Blvd., St. Louis, MO 63120. A reply will be furnished directly to you.

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CHAPTER 1

INTRODUCTION

1-1. General.

These instructions are for use by the operator. They apply to Army OH-58C helicopter.

1-2. Warnings, Cautions, and Notes.

Warning, cautions, and notes are used to emphasize important and critical instructions and are used for the following conditions:

WARNING

An operating procedure, practice, etc., which, if not correctly followed, could result in personal injury or loss of life.

CAUTION

An operating procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment.

NOTE

An operating procedure, condition, etc., which it is essential to highlight.

1-3. Description.

This manual contains the complete operating instructions and procedures for the OH-58C helicopter. The observance of procedures is mandatory except when modification is required because of multiple emergencies, adverse weather, terrain, etc. Your flying experience is recognized, and therefore, basic flight principles are not included. It is required that **THIS MANUAL BE CARRIED IN THE HELICOPTER AT ALL TIMES.**

1-4. Appendix A, References.

Appendix A is a listing of official publications cited within the manual applicable to and available for flight crews.

1-5. Index.

The index lists, in alphabetical order, every titled paragraph, figure, and table contained in this manual. Chapter 7 performance data shall have an additional index within the chapter.

1-6. Abbreviations.

For information concerning abbreviations, refer to Chapter 7.

1-7. Army Aviation Safety Program.

Reports necessary to comply with the safety program are prescribed in AR 385-40.

1-8. Destruction of Army Material to Prevent Enemy Use.

For information concerning destruction of Army material to prevent enemy use, refer to TM 750-244-1-5.

1-9. Deleted.

1-10. Forms and Records.

Army aviators flight record and aircraft maintenance records which are to be used by crewmembers are prescribed in TM38-750 and TM55-405-9.

1-11. Deleted

1-12. Explanation of Change Symbols.

Changes, except as noted below, to the text and tables, including new material on added pages, are indicated by a vertical line in the outer margin extending close to the entire area of the material affected; exception: pages with emergency markings, which consist of black diagonal lines around three edges, may have the vertical line or change symbol placed along the inner margins. Symbols show current changes only. A miniature pointing hand symbol is used to denote a change to an illustration. However, a vertical line in the outer margin, rather than miniature pointing hands, is utilized when there have been extensive changes made to an illustration. Change symbols are not utilized to indicate changes in the following:

- a. Introductory material.

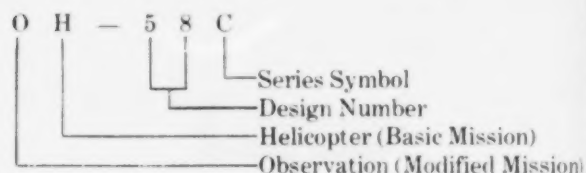
- b. Indexes and tabular data where the change cannot be identified.

- c. Blank space resulting from the deletion of text, an illustration, or a table.

- d. Correction of minor inaccuracies, such as spelling, punctuation, relocation of material, etc., unless such correction changes the meaning of instructive information and procedures.

1-13. Helicopter Designation System.

The designation system prescribed by AR70-50 is used in helicopter designations as follows:



1-14. Use of Words Shall, Should, and May.

Within this technical manual the word "shall" is used to indicate a mandatory requirement. The word "should" is used to indicate a nonmandatory but preferred method of accomplishment. The word "may" is used to indicate an acceptable method of accomplishment.

CHAPTER 2

HELICOPTER AND SYSTEM DESCRIPTION AND OPERATION

Section 1. HELICOPTER

2-1. General.

The OH-58C helicopter (figure 2-1) is a single engine, observation type helicopter designed for landing and take off from prepared or unprepared surfaces. The fuselage consists of the forward section, intermediate section, and the aft or tail boom section. The forward section provides the cockpit, cabin, and fuel cell enclosure as well as pylon support. Entrance to the cockpit is provided by two cabin doors, one on each side. The pilot station (figure 2-4) is located on the right and the copilot/observer station is located on the left side of the helicopter. The cabin may be used as a cargo or passenger compartment. The intermediate section supports the engine and includes the battery and avionics compartment. The tail boom supports the horizontal stabilizer, vertical stabilizer, and tail rotor. The basic structure of the forward section consists of a lower-curved honeycomb sandwich panel and an upper longitudinal aluminum beam. The core of the sandwich structure is aluminum alloy throughout. The faces are aluminum alloy except in the fuel cell region where they are fiberglass. The aluminum alloy sandwich panel is capable of withstanding the specified design cargo loadings, while the fiberglass sandwich supports the fuel cell pressures. The rotor, transmission and engine are supported by the upper longitudinal beam. The upper and lower structures are interconnected by three fuselage bulkheads and a centerpost to form an integrated structure. The most forward and aft bulkheads act as carry-through structure for the skid landing gear crosstubes. The tailboom is a monocoque structure with aluminum skin and aluminum substructure.

a. Dimensions. Principal dimensions of the helicopter areas are shown in figure 2-2.

b. Turning Radius and Ground Clearance. Refer to figure 2-3.

c. Weights. The helicopter weight empty and gross operating weight will change according to

the configuration or equipment installed for the type of mission to be performed. Refer to Chapter 6, Weight and Balance Computation.

d. Crew Configuration. The crew consists of the pilot alone or pilot and copilot, or pilot and observer.

2-2. Landing Gear System.

a. Standard Skid Gear. The landing gear system is a skid type, consisting of two laterally mounted arched cross tubes, attached to two formed longitudinal skid tubes. The landing gear structure members are made from formed aluminum alloy tubing with steel skid shoes to minimize skid wear. The gear assembly is attached with clamps at four points to the fuselage structure (figure 2-2).

b. High Skid Gear. The high skid gear, when installed, will provide an approximate 12 additional inches of ground clearance. The high skid gear improves landing capabilities in snow and rough terrain areas (figure 2-2).

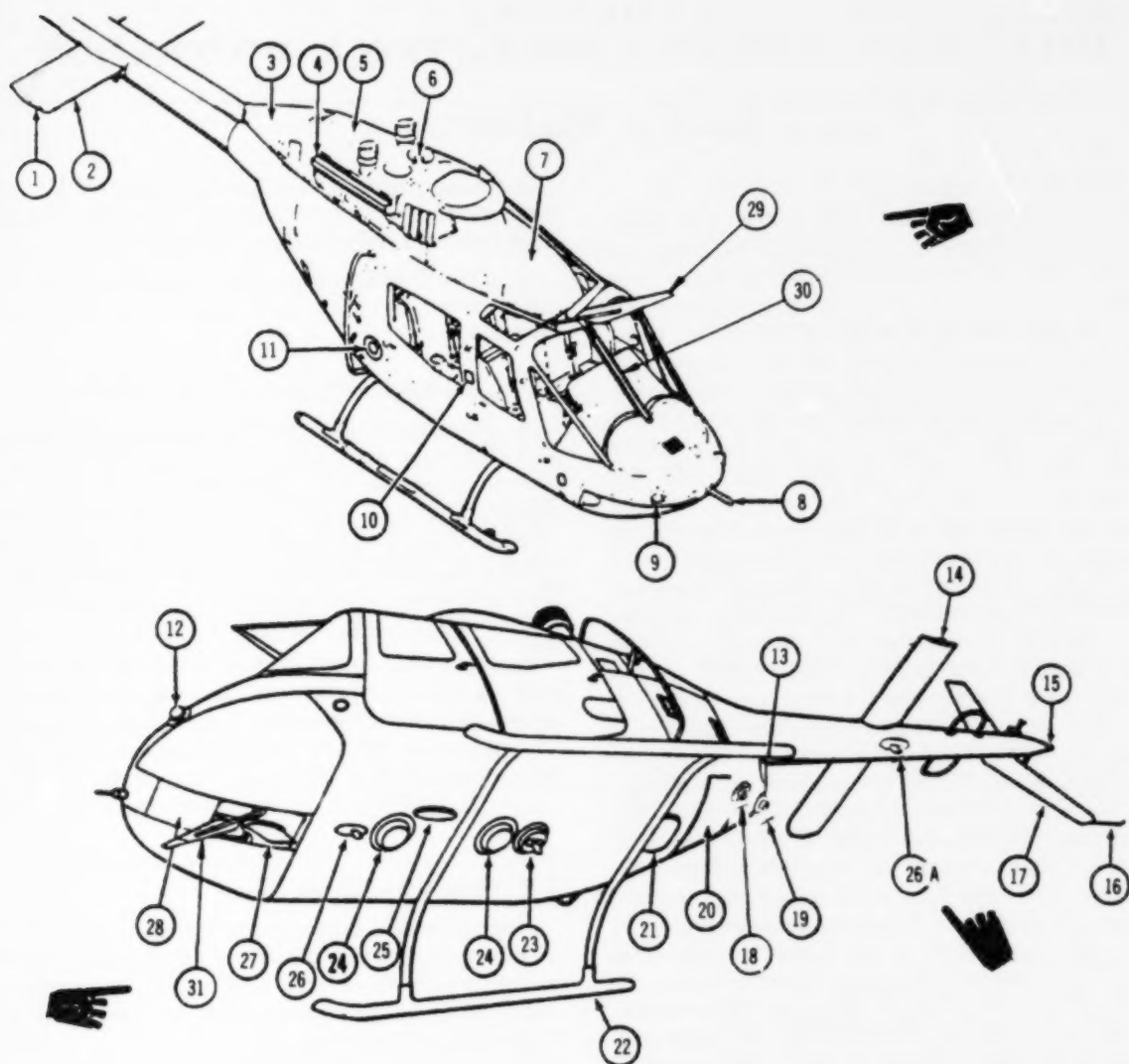
2-3. Cockpit and Cabin Doors.

Four entrance doors are provided for access to the aircraft interior. The doors are of bonded sheet metal construction with acrylic plastic windows. Each door may be jettisoned by means of an emergency jettison handle.

WARNING

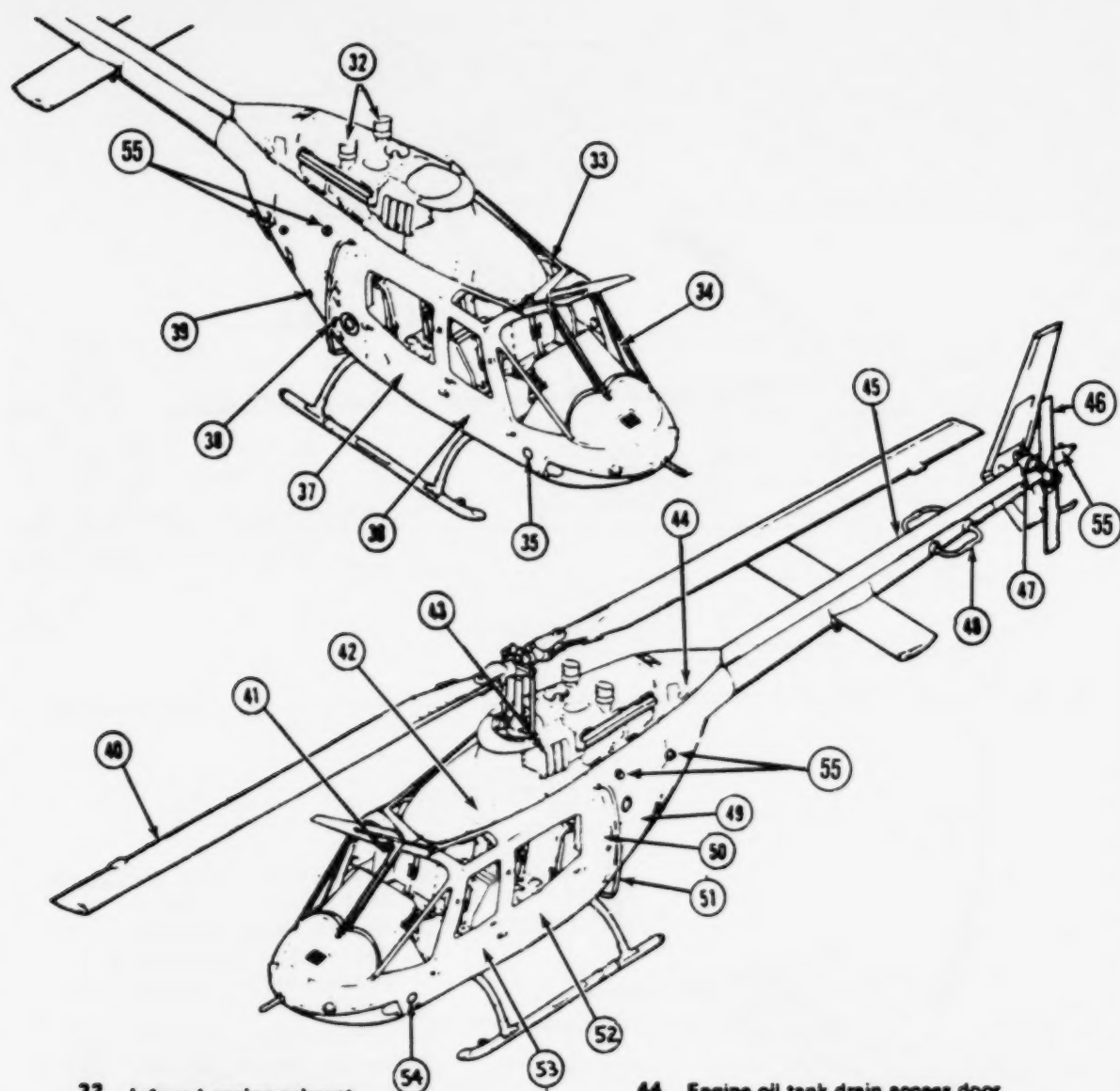
Inadvertent jettisoning of cockpit doors is possible if emergency jettison handle is used as a handhold or hand rest during flight.

All four doors are provided with door lock devices. The pilot door has a padlock while the other three doors have loop locking devices (figure 2-9).



- | | |
|--|--|
| 1. Position light (green) | 17. Vertical fin |
| 2. Horizontal stabilizer | 18. Lower anti-collision light |
| 3. Engine oil tank cowling | 19. Aft proximity warning antenna |
| 4. Infrared suppression shield | 20. ADF sense antenna |
| 5. Aft engine cowling | 21. ADF loop antenna |
| 6. Upper anti-collision light | 22. Landing gear |
| 7. Forward transmission fairing | 23. Radar warning blade antenna |
| 8. Pitot tube | 24. Radar altimeter antenna |
| 9. Right forward radar warning antenna | 25. Marker beacon antenna |
| 10. Door lock | 26. Bottom transponder antenna |
| 11. Fuel filler cap | 26A. Transponder Antenna (if APR 209 is installed) |
| 12. Left forward radar warning antenna | 27. UHF antenna |
| 13. Left aft radar warning antenna | 28. Landing light |
| 14. Position light (red) | 29. Upper Cutter Assembly |
| 15. Position light (white) | 30. Windshield Deflector |
| 16. Tail skid | 31. Lower Cutter Assembly |

Figure 2-1. General arrangement (Sheet 1 of 3)



- 32. Infrared engine exhaust
- 33. FM no. 2 antenna
- 34. Windshield
- 35. Right static port
- 36. Pilot door
- 37. Cabin door
- 38. Battery vent
- 39. External power receptacle
- 40. Main rotor blades and hub
- 41. Free air temperature (FAT) gage
- 42. Forward transmission fairing inspection door
- 43. Engine air inlet

- 44. Engine oil tank drain access door
- 45. Tail rotor driveshaft cover
- 46. Tail rotor blade and hub
- 47. Tail rotor gearbox
- 48. VOR antenna
- 49. Battery and avionics compartment door
- 50. Step
- 51. FM homing antenna
- 52. Cabin door
- 53. Copilot/observer door
- 54. Left static port
- 55. NVG Position Lights

Figure 2-1. General arrangement (Sheet 2 of 3)

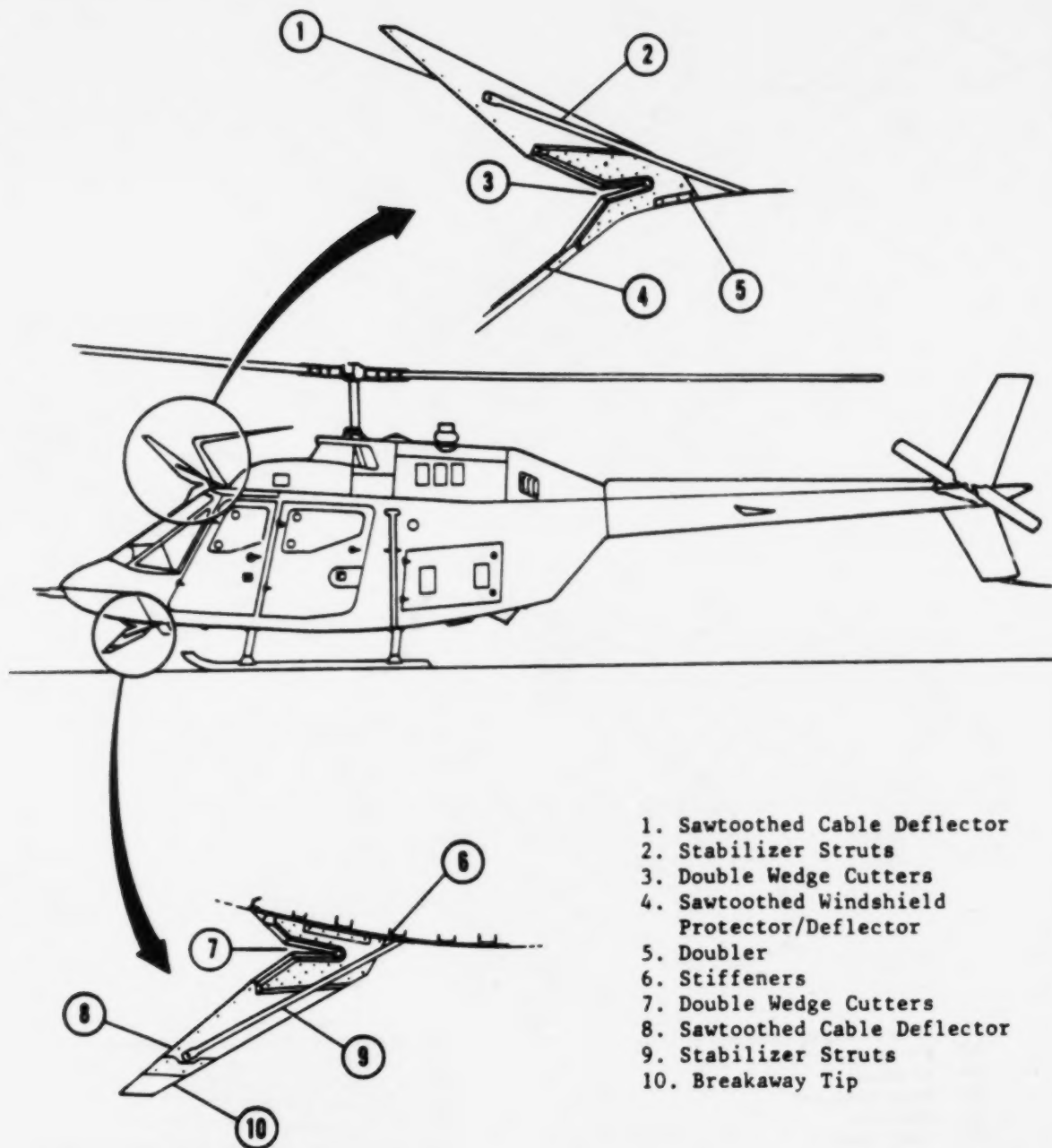


FIGURE 2-1. WSPS Configuration (Sheet 3 of 3)

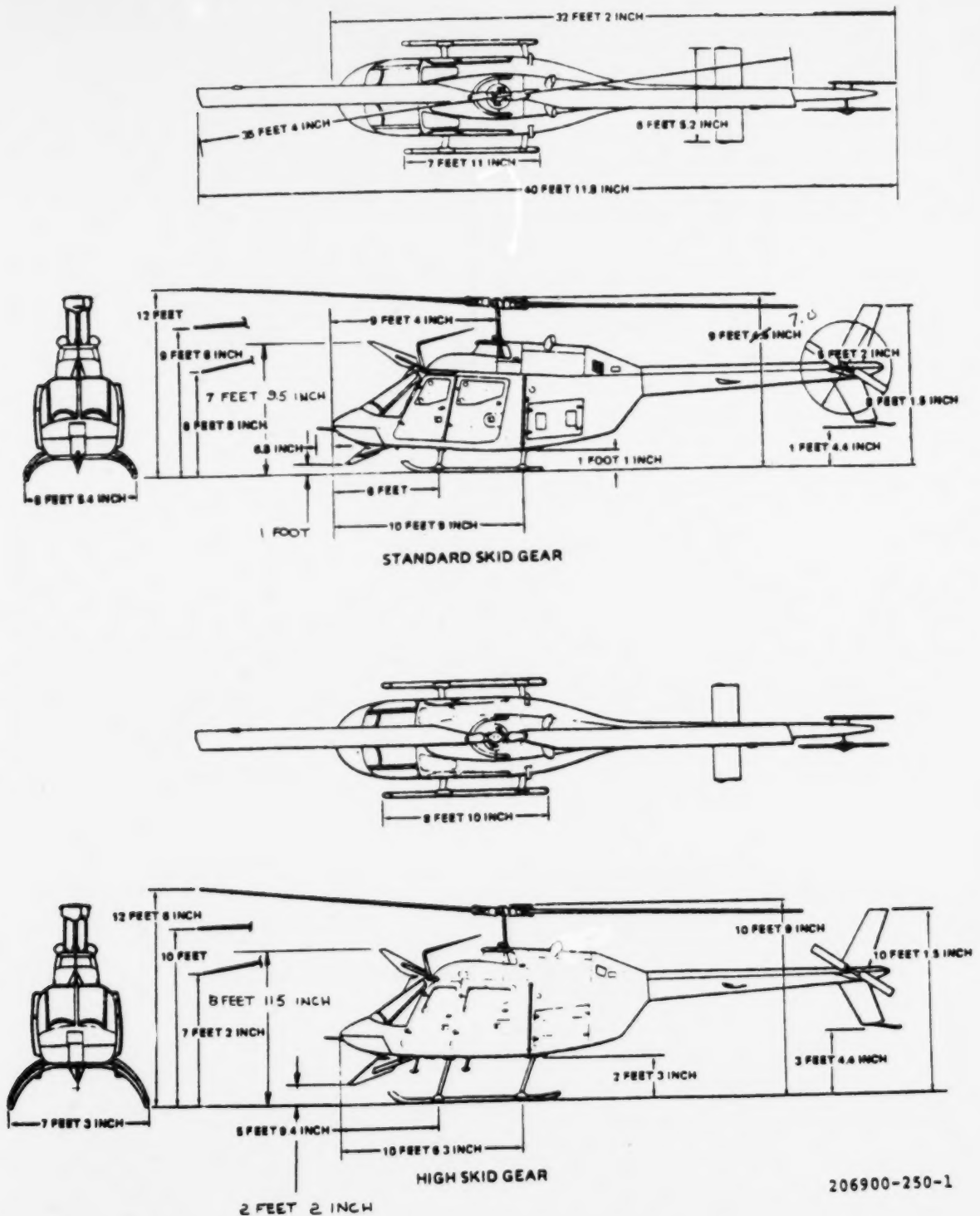
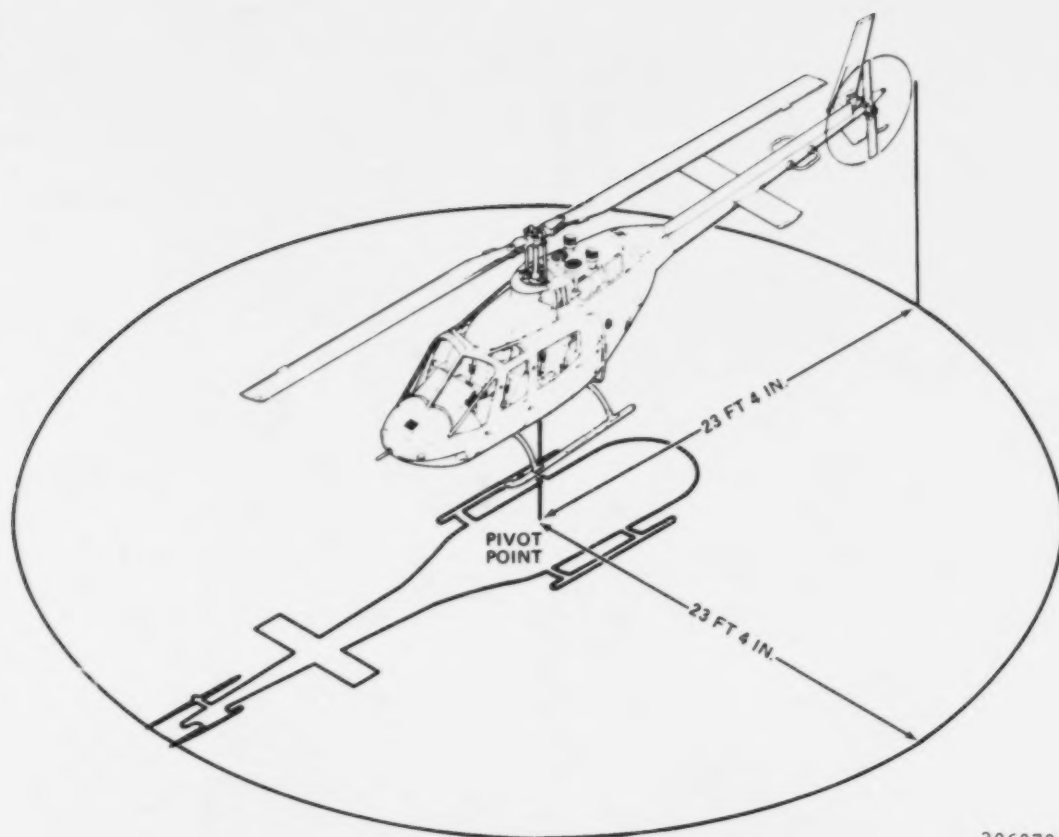
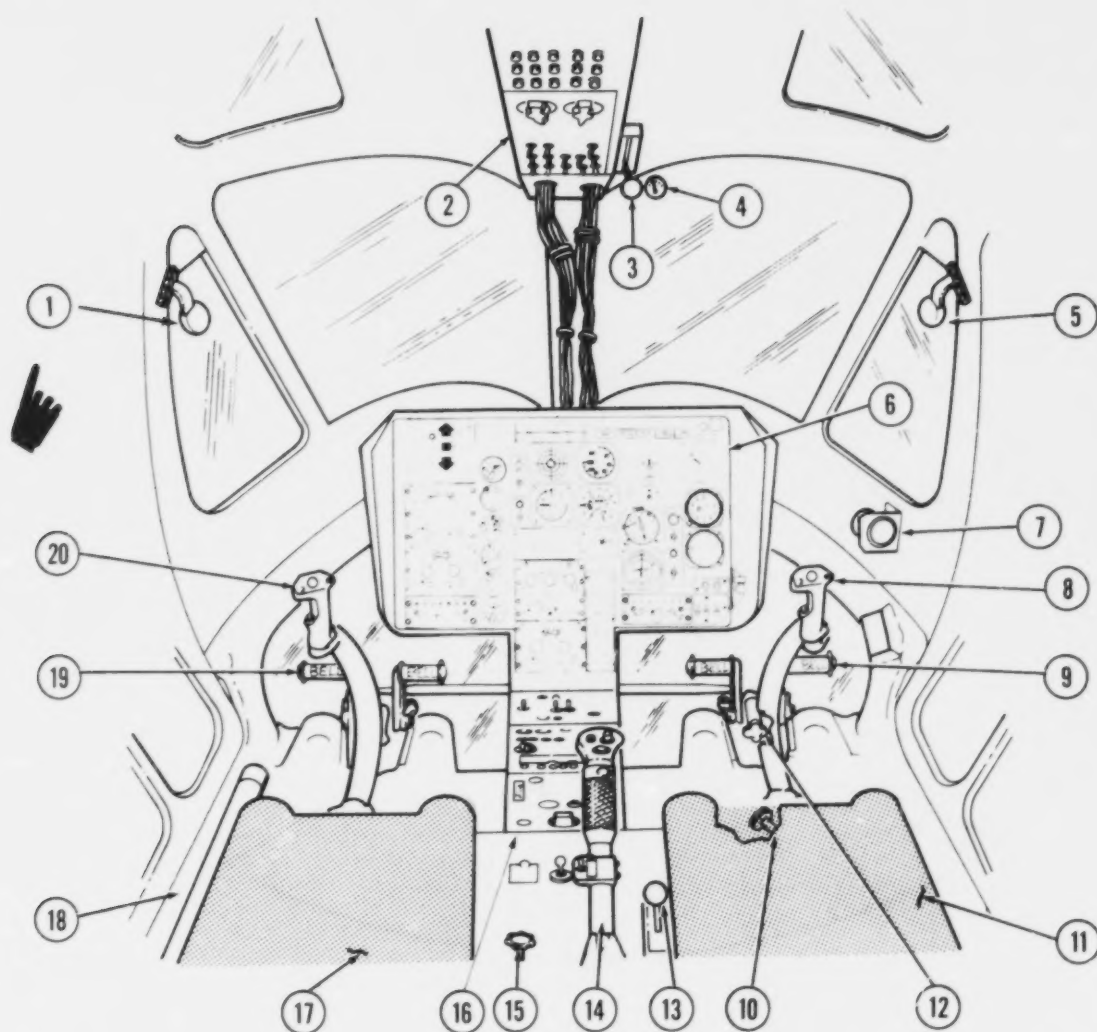


Figure 2-2. Principal dimensions



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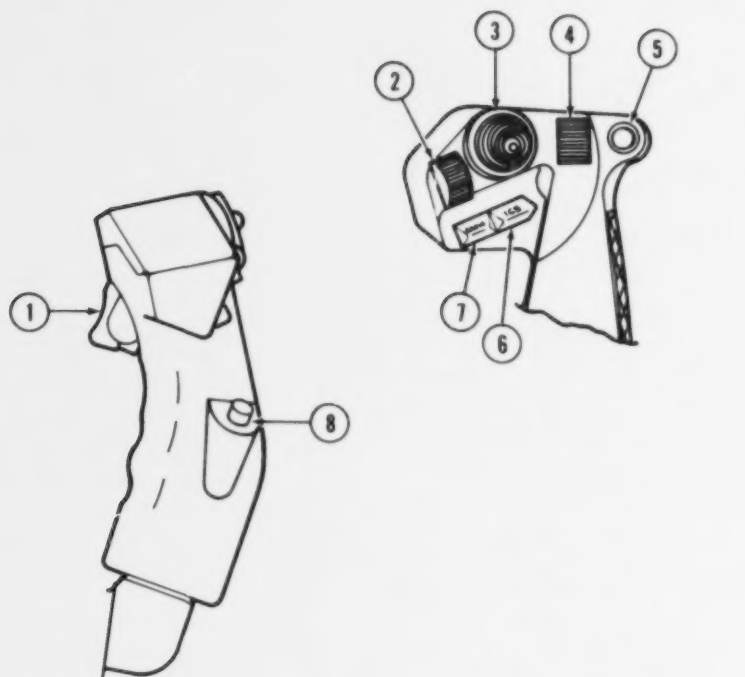
Figure 2-3. Turning radius and general clearance



- | | |
|---|--|
| 1. Copilot door emergency jettison handle | 11. Pilot seat |
| 2. Overhead console | 12. Anti-torque pedal adjuster |
| 3. Fuel ON/OFF control handle | 13. Shoulder harness lock |
| 4. Free air temperature (FAT) gage | 14. Pilot collective lever |
| 5. Pilot door emergency jettison handle | 15. Collective friction control adjustment |
| 6. Instrument panel | 16. Console |
| 7. Magnetic compass | 17. Copilot/observer seat |
| 8. Pilot cyclic stick | 18. Copilot collective lever |
| 9. Pilot anti-torque pedals | 19. Copilot anti-torque pedals |
| 10. Cyclic friction control adjustment | 20. Copilot cyclic stick |

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Figure 2-4. Pilot and copilot/observer station diagram



- 1. Not used
- 2. Night vision goggles light switch
- 3. Not used
- 4. Not used

- 5. Force trim switch
- 6. ICS switch
- 7. Radio transmit switch
- 8. Not used

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Figure 2-5. Cyclic controls

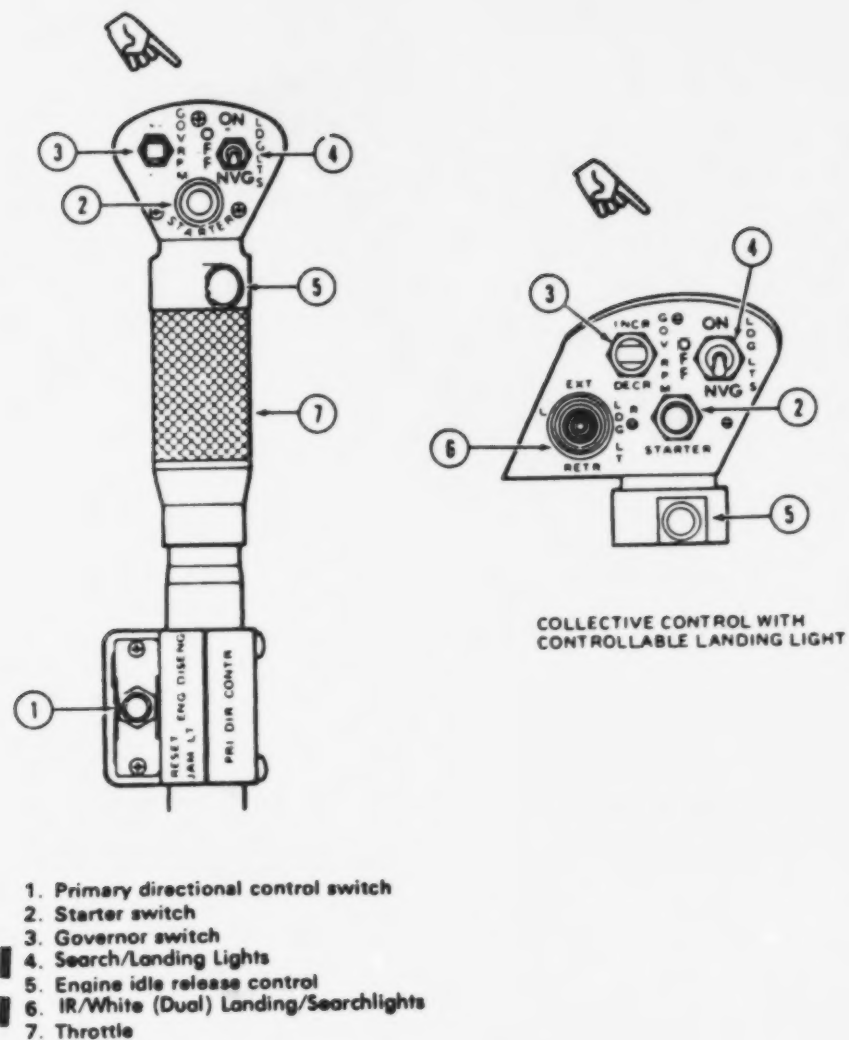
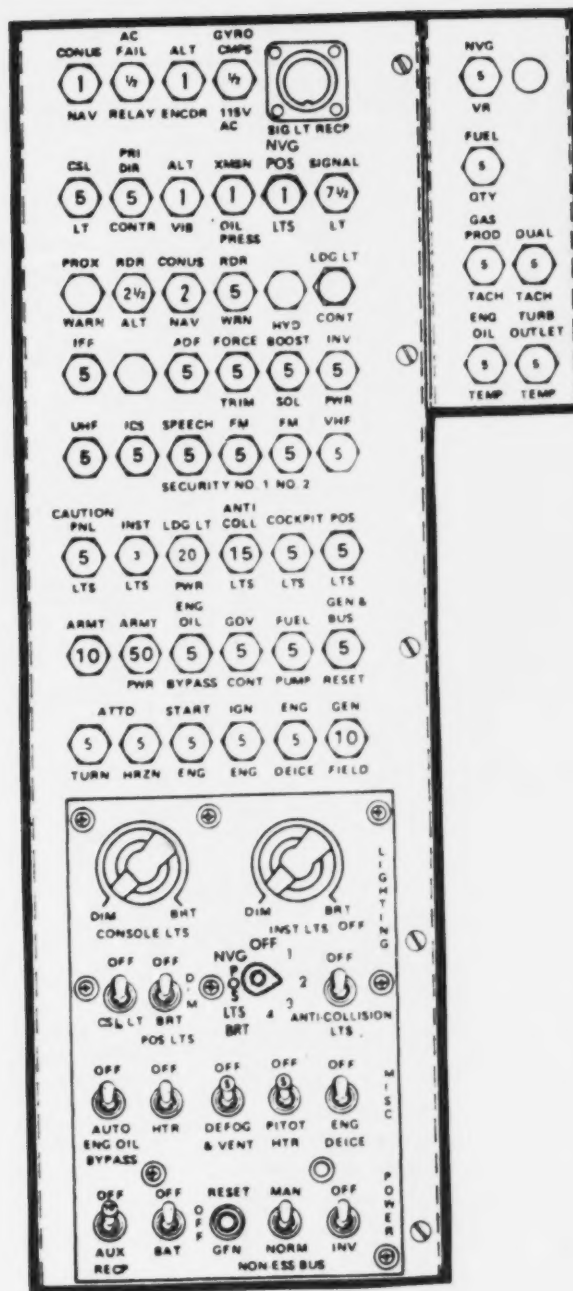


Figure 2-6. Pilot collective controls



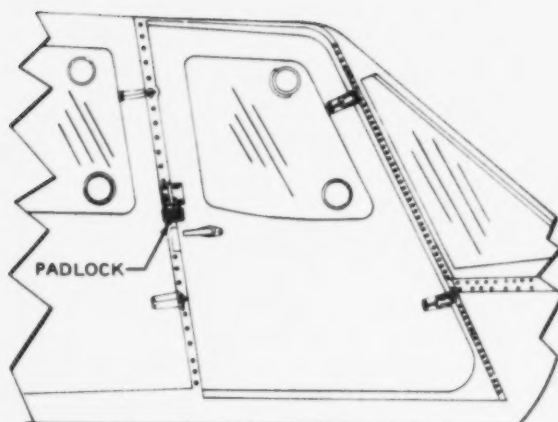


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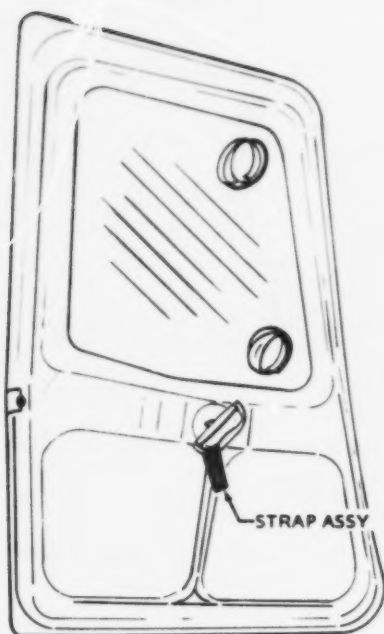
Figure 2-8. Overhead console



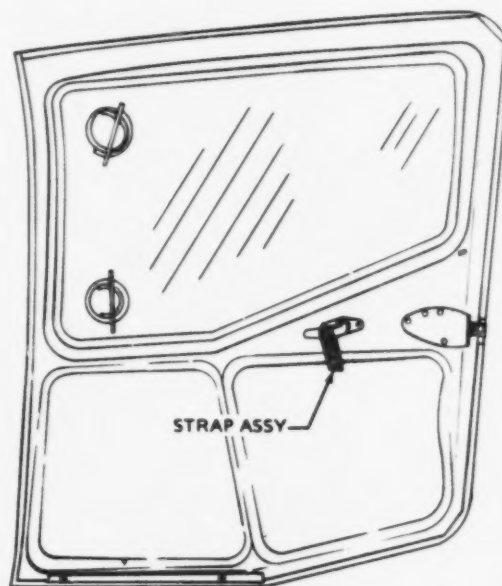
LEFT CABIN DOOR



PILOT DOOR



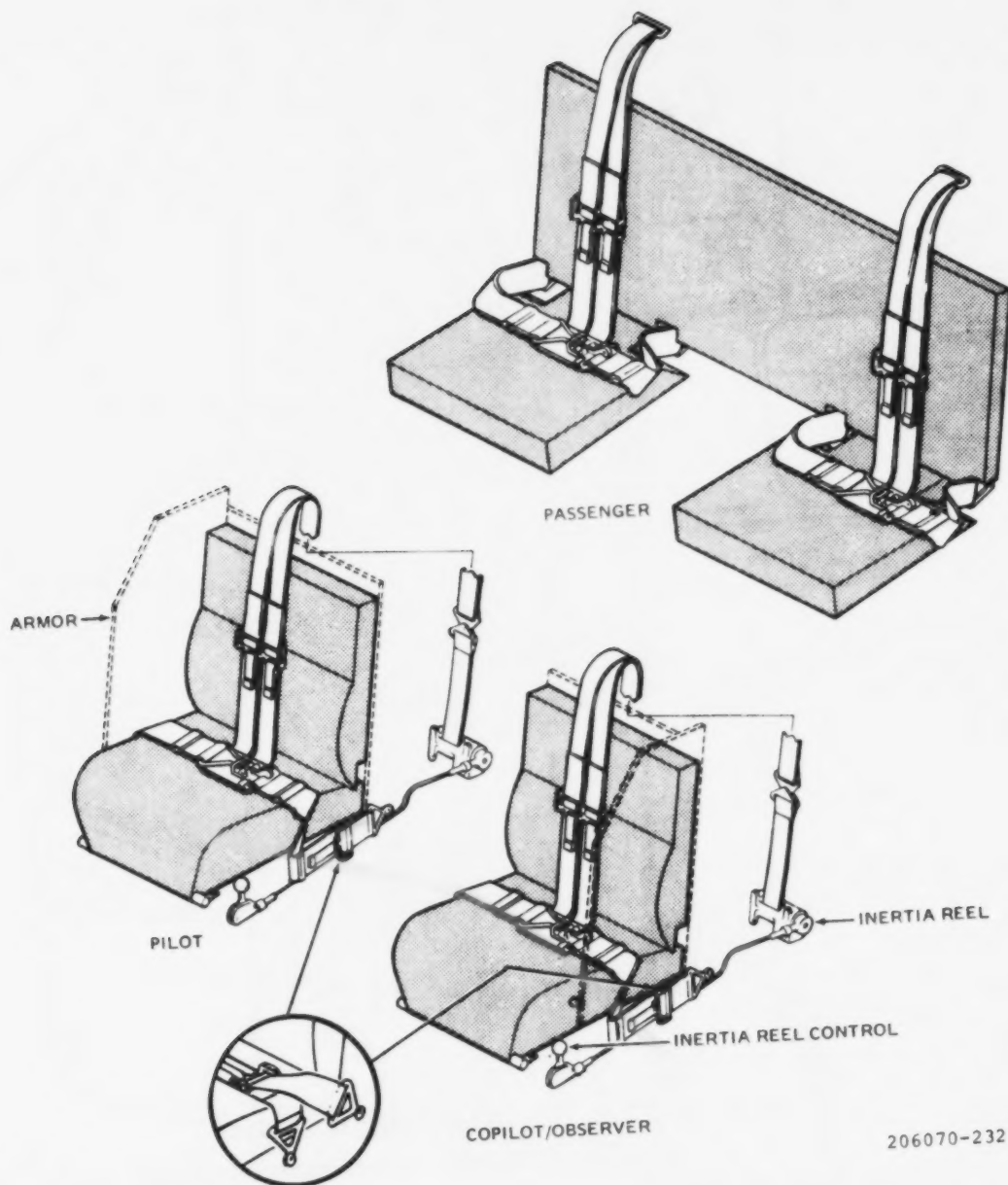
COPILOT/OBSERVER DOOR



RIGHT CABIN DOOR

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Figure 2-9. Locking devices for doors



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Figure 2-10. Pilot, Copilot, Passenger Seats (Sheet 1 of 2)

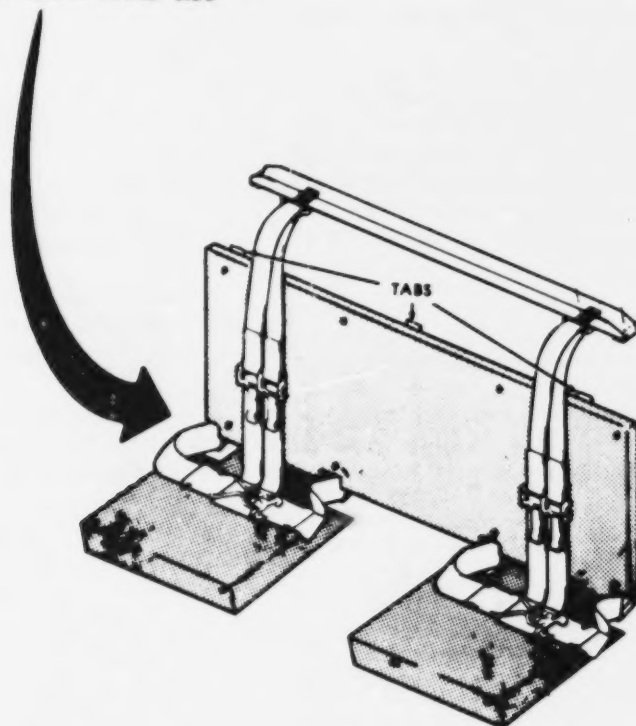
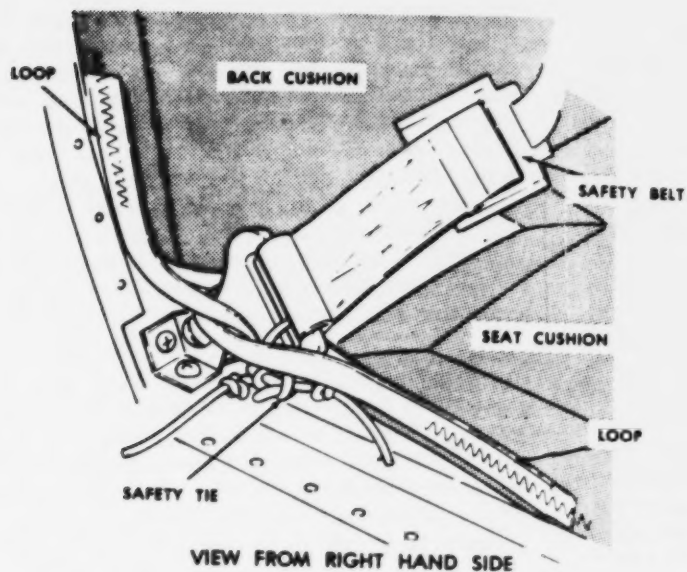


Figure 2-10. Pilot, Copilot, and Passenger Seats (Sheet 2 of 2)

2-4. Seats.

a. Pilot and Copilot/Observer Seats. The pilot and copilot/observer seats are constructed of tubing and stretched nylon material. Each seat is equipped with provisions for cushions, safety belts, and shoulder harness. An inertia reel, with a manually operated control handle, is incorporated on each seat. The inertia reel is a mechanical restraining device that is designed to hold pilot in a normal seated position during any maneuver which would tend to pitch him forward. Each reel is connected to a shoulder harness with a web strap. An automatic locking mechanism, a webbing roller, and a manual control are incorporated in each unit (figure 2-10).

b. Passenger Seats. The passenger seats are constructed of aluminum honeycomb panels and form an integral part of the airframe. The center panel of the seat back is removable to gain access to fuel cell. Seats are equipped with shoulder harness, safety belts, and cushions. Seating is provided for two passengers or without seats, space is provided for cargo (figure 2-10).

2-4.1 Wire Strike Protection System (WSPS).

WARNING

Flight with the landing light in other than the fully stowed position on OH-58 aircraft may degrade the effectiveness of the wire strike protection system (WSPS). When use of the controllable landing light is not anticipated, it should be in the fully stowed position.

The WSPS provides protection against frontal impacts with horizontally strung mechanical and power transmission cables. The basic system con-

sists of an upper cutter/deflector, a windshield protector/deflector/cutter and a lower cutter/deflector (Figure 2-1, Sheet 3 of 3). The windshield protector/deflector/cutter, consisting of a sawtooth equipped aluminum extrusion, provides deflection mechanism into the upper cutter while simultaneously abrading thus weakening cable and provides additional structural support for the upper cutter mounting. The mechanical cutter/deflector (upper and lower) consists of a sawtooth equipped deflector section, providing deflection/abrading feature similar to the windshield deflector section, leading into the primary cable cutting mechanism - wedge type cutting blades positioned to provide the necessary mechanical advantage to cut the design objective cables while minimizing load input into the airframe. The lower cutter assembly features a "Breakaway Tip" designed to shear when relatively large ground contact forces are experienced and before helicopter structural damage is incurred. However, the tip shear rivets are designed to withstand the smaller forces experienced during wire strikes and the tip will still effectively deflect wires/cables into the cutter blades.

a. Wire Strikes. If avoidance is not possible or not effective a wire strike will occur. The protection provided by the WSPS is 90% of frontal area. The cable impact/deflection/cutting sequence of the design objective cables does not have a significant effect on aircraft performance, control, crew functioning or blade flapping.

b. Avoidance. The most effective defense against wire strikes is avoidance. Because of the many different encounters that can occur, it is not possible to provide a procedure to cover every situation. The success in coping with emergency depends on quick analysis of the condition and selection of the proper evasive maneuvers.

Section II. EMERGENCY EQUIPMENT

2-5. First Aid Kit.

An aeronautical type first aid kit is located on the right side of the enter support column (figure 9-1).

2-6. Fire Extinguisher.

A portable fire extinguisher (CF3BR) is carried in a bracket located on the right side of the center support column (figure 9-1).

Section III. ENGINES AND RELATED SYSTEMS.

2-7. Engine.

The OH-58C helicopter is equipped with a T63-A-720 gas turbine engine (figure 2-11). The engine is installed in the intermediate section. The major engine components are as follows:

a. Compressor. Air enters the engine through the compressor inlet and is compressed by six axial compressor stages and one centrifugal stage. The compressed air is discharged through the scroll type diffuser into two compressor discharge tubes which convey the air to the combustion section.

b. Combustion Section. The combustion section consists of the outer combustion case and the combustion liner. A spark igniter and a fuel nozzle are mounted in the aft end of the outer combustion case. Air enters the combustion liner at the aft end through holes in the liner. The air is mixed with fuel sprayed from the fuel nozzle and combustion occurs. Combustion gases move forward out of the combustion liner to the first-stage gas producer turbine nozzle.

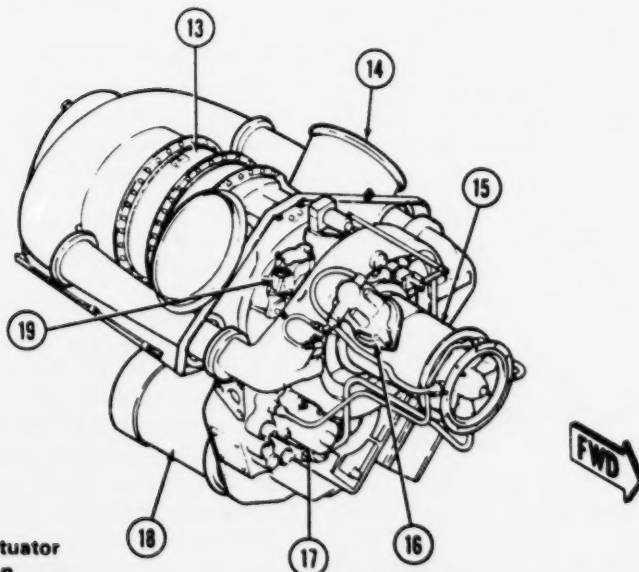
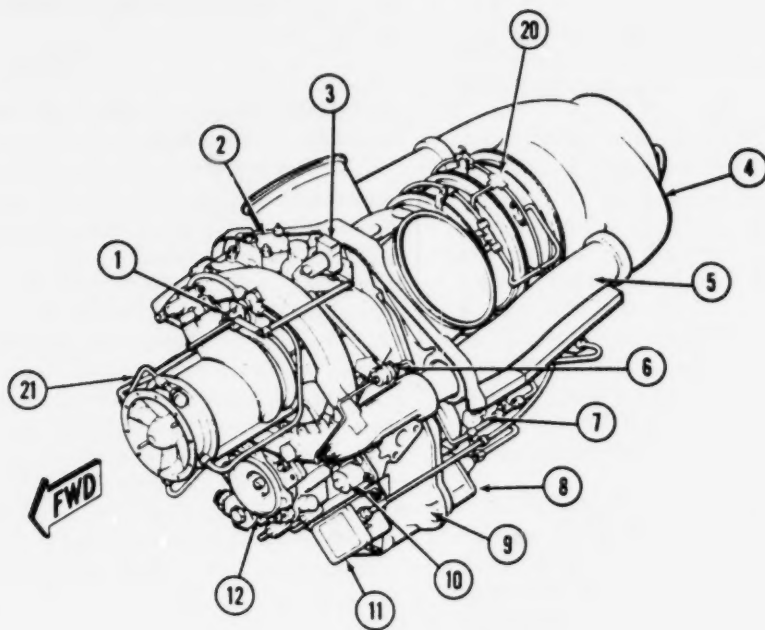
c. Turbine. The turbine consists of a gas producer turbine support, a power turbine support, a turbine and exhaust collector support, a two-stage

gas producer turbine (N1) and a two-stage power turbine (N2). The turbine section is mounted between the combustion section and accessory gearbox. The two-stage gas producer turbine drives the compressor and accessory gear train. The two-stage power turbine furnishes the output power of the engine.

d. Power and Accessories Gearbox. The power and accessories gear trains are enclosed in a single gear case. All engine components, including the engine mounted accessories, are attached to the case. The gearbox reduces rotational speed from the power turbine to the output drive spline. Accessories driven by the power turbine gear train are the power turbine tachometer-generator, power turbine governor, and torque meter. The gas producer drives the compressor, fuel pump, gas producer fuel control, gas producer tachometer-generator, starter generator, and engine oil pump.

2-8. Engine Cooling.

Openings are provided on both sides and the top of the engine cowling for compartment cooling. Below



- 1. Anti-ice valve
- 2. Oil filter
- 3. Anti-ice control actuator
- 4. Combustion section
- 5. Compressor discharge tubes
- 6. Air filter
- 7. Power turbine governor
- 8. Fuel pump and filter
- 9. Accessory gearbox
- 10. Tachometer generator (power turbine)
- 11. Ignition exciter assembly
- 12. Freewheeling unit

- 13. Turbine section
- 14. Exhaust stack
- 15. Compressor section
- 16. Compressor bleed valve assembly
- 17. Tachometer generator (gas producer)
- 18. Starter generator
- 19. Oil pressure regulator
- 20. TOT harness
- 21. Engine oil lines

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Figure 2-11. Engine

the engine is a titanium deck which acts as a drip pan and also gives insulation from engine heat.

2-9. Induction System.

The engine air inlet system consists of an induction fairing with air inlets on each outboard side. This fairing provides mounting for the particle separator.

Foreign matter is removed from the engine inlet air by a centrifugal-type particle separator. Clean air enters the engine inlet plenum chamber through the outlet tube while foreign material is centrifuged into the scavenge system. The foreign material is ejected overboard by the vacuum-cleaner effect created by engine bleed air as it is discharged through venturies in the eductor tubes. Reverse flow inlet fairings may be attached to the engine air inlets. These sheet metal fairings make it impossible for air to enter the plenum chamber without first making two 180° turns. These abrupt changes in airflow greatly reduce the probability of engine flameout associated with snow ingestion.

2-10. Engine Inlet Anti-Icing System.

The compressor inlet guide vanes and front bearing support hub are the only engine components with anti-icing provisions. Anti-icing is provided by the use of compressor bleed air. Anti-icing is actuated by placing ENG DEICE switch on the ON position (figure 2-8).

2-11. Engine Fuel Control System.

The system controls engine power output by controlling the gas producer speed. Gas producer speed levels are established by the action of the power turbine governor which senses power turbine speed. The power turbine speed is selected by the operator and the power required to maintain this speed is automatically maintained by power turbine governor action on metered fuel flow. The power turbine governor lever schedules the power turbine governor requirements. The power turbine governor schedules the gas producer speed to a changed power output to maintain output shaft speed.

a. Throttle. Rotating the throttle (figure 2-6) to the full open position allows the power turbine governor to maintain a constant rpm. Rotating the throttle toward the closed position will cause the rpm to be manually selected instead of automatically selected by the power turbine governor. Rotating the throttle

past the engine-idle stop to the fully closed position shuts off fuel flow. A manually operated idle stop is incorporated to prevent inadvertent throttle closure. The idle stop is controlled by the engine idle release control (figure 2-6).

b. Droop Compensator. A droop compensator maintains engine rpm (N2) as power demand is increased. The compensator is a direct mechanical linkage between the collective stick and the speed selector lever on the N2 governor. Droop is defined as the speed change in N2 rpm as power is increased from a no-load condition. Without droop compensation, instability would develop as engine output is increased, resulting in N1 speed overshooting or hunting the value necessary to satisfy the new power condition. If N2 power is allowed to droop, other than momentarily, the reduction in rotor speed could become critical.

c. Engine Idle Release Control. The engine idle release is a spring loaded plunger mounted on the pilot collective lever (figure 1-6). The plunger prevents the pilot from accidentally retarding the power control beyond engine idle position. This acts as a safety feature by preventing inadvertent engine shutdown. The plunger need not be depressed when performing engine start or runup; however, the plunger must be depressed when accomplishing an engine shutdown or when it is desired to retard the power control below the engine idle position.

d. Governor RPM switch. The GOV RPM INCR/DECR switch is mounted on the pilot collective lever switchbox (figure 2-6). The switch is a three-position momentary type and is held in the INCR position to increase the power turbine (N2) speed or DECR position to decrease the power turbine speed. Regulated power turbine speed may be adjusted through the operating range by movement of the switch as required. This range extends from 94% to 101%.

e. Fuel Pump and Filter Assembly. The fuel pump and filter assembly incorporates a single gear-type pumping element, a low pressure barrier filter, a filter bypass valve, and a bypass pressure regulating valve. Fuel enters the engine fuel system at the inlet port of the pump and passes through the low pressure filter before entering the gear element. The filter bypass valve allows fuel to bypass the filter element if it becomes clogged.

The bypass return flow from the fuel control is passed back to the inlet of the gear element through a pressure regulating valve which maintains the bypass flow pressure above inlet pressure.

f. Power Turbine Governor. The power turbine speed is scheduled by the power turbine governor lever and the power turbine speed scheduling cam. The cam sets a governor spring load which opposes a speed-weight output. Overspeed protection of the power turbine governor becomes effective at approximately 108% N2. This governing action will result in a pulsating increase/decrease of engine power.

g. Fuel Nozzle. The fuel nozzle is a single-entry dual-orifice type unit which contains an integral valve for dividing primary and secondary flow

2-12. Infrared Suppression System.

The infrared suppression system is specially formulated to reduce detection of IR-seeking missiles. The system consists of two exhaust stacks located at the top of the engine cowling and two shields located on the side engine cowling (figure 2-1). The exhaust stacks have cooling fins and a shield around them to reduce the infrared signature of the hot engine exhaust. The shields on the side engine cowling prevent detection of the hot engine area from the sides.

2-13. Temperature Measurement System.

The temperature measurement system consists of four chromel-alumel single junction thermocouples in the gas producer turbine outlet and an associated integral terminal. The voltages of the four thermocouples are electrically averaged in the assembly and indicated on the turbine outlet temperature (TOT) indicator.

2-14. Compressor Bleed Air Valve.

The compressor bleed valve permits rapid engine response during starting and acceleration. The system consists of a compressor discharge pressure sensing port on the scroll, tubing from the sensing port to the bleed valve, and a compressor bleed valve. The compressor bleed control valve is closed by compressor discharge pressure during engine operation.

2-15. Engine Oil Supply System.

The lubrication system is a dry sump type with an external tank and cooler. A gear type pressure and scavenge pump assembly is mounted in the accessory gearbox. The oil filter, filter bypass valve, and pressure regulating valve are in a unit which is

located in the upper right side of the power and accessory gearbox and are accessible from the top of the engine. The oil tank is mounted aft of the engine rear firewall on top of the intermediate cabin section. A check valve is located between the filter and engine. Probe type magnetic chip detectors are installed at the bottom of the accessory gearbox, and the engine oil outlet connection. The oil cooler blower is an integral part of the tail rotor drive and is located adjacent to the oil tank. Air discharges from the blower upward through the engine oil cooler and to the transmission oil cooler.

2-16. Ignition System.

The engine ignition system consists of a low tension capacitor discharge ignition exciter, a spark igniter lead, and a shunted surface gap spark igniter. The system derives its input power from the 28-volt DC helicopter electrical system. The IGN ENG circuit breaker protects the system from overload. The ignition system includes an ignition lock (figure 2-7) that locks out the starter system to prevent unauthorized use of the helicopter or injury to personnel or serious damage to the equipment.

2-17. Starter.

The STARTER switch (figure 2-6), located on the collective stick switch box, is a push button type switch and is pressed and held to start the engine. The switch is released when the engine start is complete or the time limit expires. When the switch is pressed the circuit to the starter relay, igniter, and the fuel boost pump is energized. The ignition keylock switch must be in the ON position to complete the starter ignition circuit. The circuits are powered by the 28 Vdc essential bus and protected by the START ENG, IGN ENG, and FUEL PUMP circuit breakers.

2-18. Engine Automatic Relight System.

The engine automatic relight system will provide engine re-ignition capability in the event of an engine flameout. The ENGINE RELIGHT ON/OFF switch (figure 2-7) is spring loaded to the ON position and will actuate the system when bleed air has decayed as a result of a flameout or engine shutdown. The ENGINE RELIGHT light (figure 2-7) will illuminate when the system is actuated. The system will recycle only if the engine ignites after a flameout.

2-19. Engine Instruments and Indicators.

a. Engine Out Warning. A rpm sensor is connected to the gas producer tachometer generator. Power is supplied through the CAUTION PNL LT circuit breaker and connections are made to the ENGINE OUT warning light (figure 2-7 and 2-15), and to a tone generator which produces a tone in the crewmembers headset. The engine out audio tone is the same as the low rotor tone. The warning system is activated at 55 ± 3 percent (N1) and is de-activated when this gas producer percent is reached. The ENGINE OUT illuminates steady until engine is restarted.

b. Engine Out Audio Warning. A switch connected to the collective lever disables the engine out audio warning when the collective lever is in the full down position.

c. Torquemeter. The torquemeter (figure 2-7), located in the instrument panel, displays percent of torque produced by the engine. The torquemeter is a direct reading, wetline indicator.

d. Turbine Outlet Temperature Indicator. The turbine outlet temperature (TOT) indicator (figure 2-7), located in the instrument panel, displays temperature in degrees celsius of the exhaust gases in the N_1 turbine outlet area. The indicator is powered by 28 Vdc and protected by TURB OUTLET TEMP circuit breaker.

e. Gas Producer Tachometer. The gas producer tachometer (figure 2-7), located in the instrument panel, displays the rpm of the gas producer turbine speed in percent. The circuit is powered by 28 Vdc and protected by the GAS PROD TACH circuit breaker.

f. Dual Tachometer. The dual tachometer (figure 2-7), located in the instrument panel, displays the rpm of the power turbine and main rotor in percent. The

tachometer outer scale is marked ENGINE and the inner scale is marked ROTOR. The ENGINE and ROTOR needles are synchronized at normal operating rpm. The circuit is powered by 28 Vdc and protected by the DUAL TACH circuit breaker.

g. Oil Pressure/Temperature Indicator. The engine oil pressure/temperature indicator (figure 2-7), located in the instrument panel, displays engine oil pressure in psi and temperature in degrees Celsius. The temperature circuit is powered by 28 Vdc and protected by ENG OIL TEMP circuit breaker. The oil pressure portion of the indicator is a direct reading wetline system.

h. Engine Oil Bypass Caution Light. The ENG OIL BYPASS caution light (figure 2-15), located on the caution panel, will illuminate when the oil tank level is approximately 3 pints low. With the ENG OIL BYPASS switch (figure 2-8) in the AUTO position the engine oil will bypass the oil cooler. A significant rise in engine oil temperature will occur and engine failure can occur in a few minutes due to excessive engine oil temperature and/or engine oil loss. The switch in AUTO position is designed for combat operations only (due to the potential for damage to the oil cooler by hostile fire) to provide the pilot a little additional time to fly out of the immediate enemy danger area only. The switch should be in the OFF position for operation in noncombat environment. The circuit is powered by 28 Vdc and is protected by the CAUTION PNL LTS circuit breaker.

i. Engine Chip Detector. The ENG CHIP DET caution light (figure 2-15), located on the caution panel will illuminate when sufficient metal chips to complete the electrical circuit are collected from the engine oil. The system is powered by 28 Vdc and protected by CAUTION PNL LT circuit breaker.

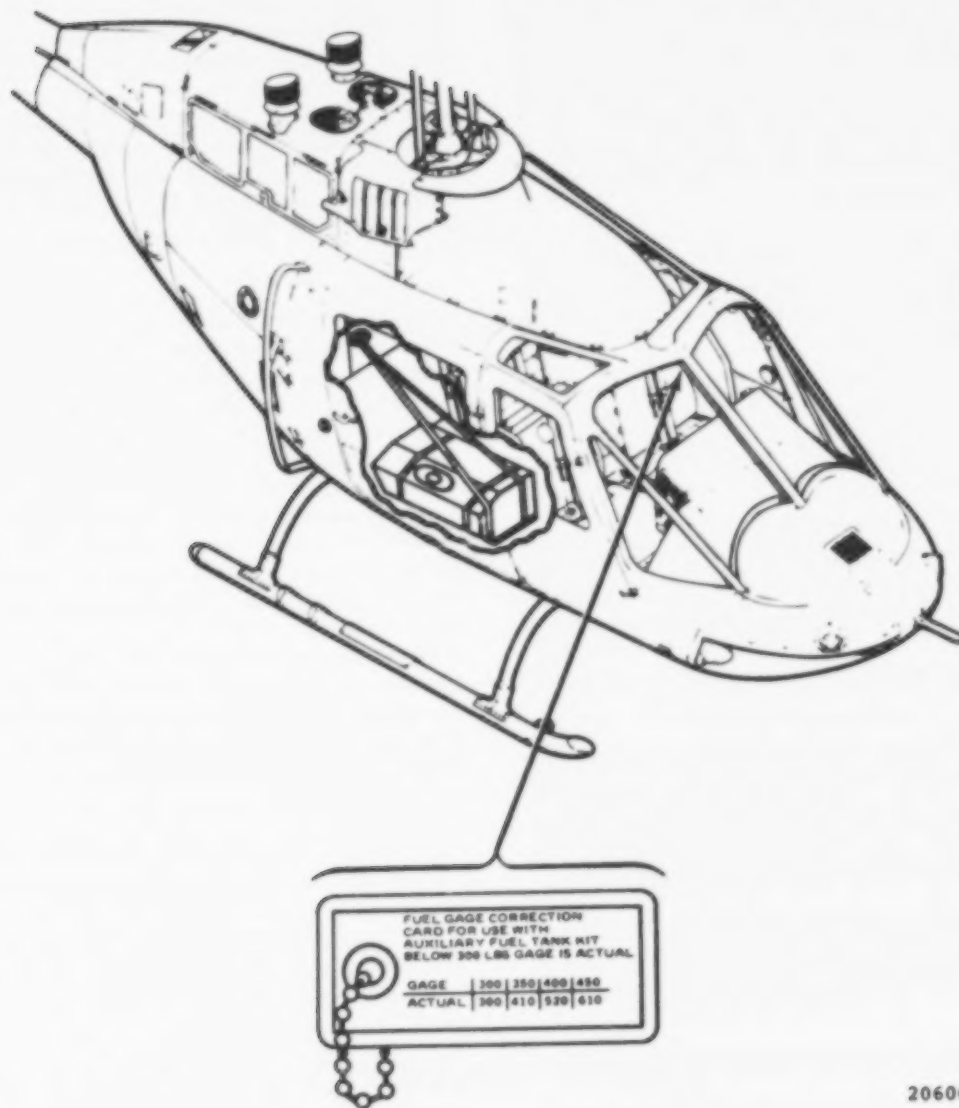
Section IV. FUEL SYSTEM

2-20. Fuel Supply System.

The helicopter is equipped with a crashworthy fuel system. The system is designed with the potential of containing fuel during a severe, but survivable, crash impact to reduce the possibility of fire. The fuel cell has a total capacity of 71.5 U.S. gallons and incorporates the closed circuit refueling receiver.

2-21. Auxiliary Fuel System.

An auxiliary fuel cell (figure 2-12) can be installed in the helicopter. The auxiliary fuel cell, when installed, is secured in the passenger compartment on the right half of the cargo platform. The auxiliary fuel cell is a self-supporting, crash-resistant self-sealing bladder type.



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Figure 2-12. Auxiliary fuel system

a. Refer to figure 2-1 for capacity of the auxiliary fuel cell. This fuel is delivered to the main fuel system by gravity only; the pilot has no control over the flow of fuel from the auxiliary cell into the main fuel cell.

b. The auxiliary fuel cell can be filled either at the main fuel cell filler or at a filler cap on the auxiliary fuel cell. The preferred method is to service the helicopter with fuel at the main fuel filler.

c. When the auxiliary fuel cell is installed, a fuel calibration card must be used to determine the amount of fuel on board (figure 2-12).

2-22. Controls and Indicators.

a. **Fuel Quantity Indicator.** The FUEL QTY indicator (figure 2-7) is located in the instrument panel and displays the quantity of fuel in the fuel cell in pounds (0 to 600 lbs.) The indicator is powered by 28 Vdc and protected by FUEL QTY circuit breaker.

b. **Fuel Boost Caution Light.** The FUEL BOOST caution light (figure 2-15) is located on the caution panel and illuminates if the fuel boost pressure is below safe operating limits when fuel boost switch is in the ON position. To check FUEL BOOST caution light with engine running, move FUEL

BOOST switch, to ON. The FUEL BOOST caution light should illuminate then go OFF. The system is powered by 28 Vdc and protected by CAUTION PANEL LT circuit breaker.

c. **Fuel Boost Pump Switch.** The FUEL BOOST switch (figure 2-7) is located in the lower right corner of the instrument panel. The fuel boost switch will be in the fuel boost position for all normal conditions when the engine is operating and for starting. The system is powered by 28 Vdc and protected by FUEL PUMP circuit breaker.

d. **Low Fuel Quantity Caution Light.** The 20 MIN FUEL caution light (figure 2-15), located in the caution panel, should illuminate when there is approximately 65 to 97.5 pounds of total fuel remaining. The system is powered by 28 Vdc and protected by CAUTION PNL LT circuit breaker.

e. **Fuel Filter Caution Light.** The FUEL FILTER caution light (figure 2-15), located in the caution panel, will illuminate when the filter in the fuel supply line becomes partially obstructed. The system is powered by 28 Vdc and protected by CAUTION PNL LT circuit breaker. The light may illuminate momentarily when the boost pump is turned on, but it should extinguish within approximately ten seconds.

Section V. FLIGHT CONTROLS

2-23. Description.

The flight control system is a positive mechanical type, actuated by conventional helicopter controls. Complete controls are provided for both pilot and copilot. The system includes a cyclic control system, a collective control system, a directional anti-torque control system and a force trim system. A backup directional control system operating in parallel with the primary directional system, is also provided.

2-24. Cyclic Control.

The pilot's cyclic stick (figure 2-5) contains the FORCE TRIM release switch, RADIO/ICS, armament firing switch and gun elevate/depress switch. The cyclic control system controls the fore

and aft and lateral movement of the helicopter. Control feel is provided by the force trim units.

NOTE

Removal of copilot's cyclic stick can cause pilot's stick to creep slightly aft.

a. Copilot's Cyclic Stick Stowage.

NOTE

Force trim will be lost when the electrical connector is disconnected when stowing or removing the copilot's cyclic stick. Removal is authorized by the pilot and/or commander. Fuel quantity gage cannot be monitored with cyclic stick stowed.

- (1) Unscrew retaining nut on cyclic stick.
- (2) Secure cyclic stick on stowage pin and strap located on the left outboard side of the center console.

b. Copilot's Cyclic Stick Installation.

- (1) Remove cyclic stick from stowage.
- (2) Insert cyclic stick into pivot assembly on torque tube.
- (3) Secure cyclic stick in pivot assembly with retaining nut.
- (4) Insure electrical connector is installed.

2-25. Collective Pitch Control.

The pilot's collective pitch control is located to the left of the pilot's position and controls the vertical mode of flight. A rotating grip type throttle and a switch box assembly are located in the forward end of the pilot's collective pitch lever (figure 2-4 and figure 2-68). The switch box assembly contains the starter, governor engine idle release and landing lights switches. Friction can be induced into the collective system by rotating a friction device located between the pilot and copilot seats. The copilot's collective lever, located to the left of the copilot's position, contains only a twist type throttle at the forward end of the control.

a. Copilot's Collective Pitch Control Stowage.

- (1) Remove boot around copilot's stick shaft.
- (2) Loosen knurled nut at base of copilot's stick. Remove stick.
- (3) Stow stick in clips located on forward side of copilot's seat.

b. Copilot's Collective Pitch Control Installation.

- (1) Remove stick from stowage clips and insert stick in jackshaft elbow assuring engagement of throttle tube.
- (2) Secure stick in elbow with knurled nut.
- (3) Secure boot around stick shaft.

2-26. Directional Anti-Torque Systems.

Anti-torque control pedals (figure 2-4) alter the pitch of the tail rotor blades and thereby provide the means of directional control. A pedal adjuster is pro-

vided to adjust the pedal distance for individual comfort. Two systems are provided in event of a failure of either primary or backup system. Both primary and backup control systems are operating at the same time under normal conditions.

a. Primary Directional Anti-Torque System.

The primary control normally transmits the control forces because it is more rigid than the backup system. The primary controls contain pilot controlled, electrically operated disconnects which permit the pilot to disengage the primary controls if they jam. If a jam occurs, the JAM light on the PRI DIR CONTR indicator panel will illuminate when the pilot applies approximately 50 pounds pedal force to the jammed controls. The pilot will then position the PRI DIR CONTR switch to DISENG. The JAM indicator light will go out and the DISENG indicator light will illuminate when disconnection of the jammed primary control has been completed. The backup control will take over the control function. In the event a separation occurs in the primary system control linkage, the backup control system immediately takes over the control function, no pilot response is required.

b. Vulnerability Reduction (Backup) Directional Anti-Torque System. The backup control system used on this helicopter provides additional recovery options if the primary control system malfunctions. A jam in the backup control may cause the controls to be immovable at normal operating loads, but there will be no jam indication on the indicator panel. If a jam occurs, the shear links in the backup system will release when a pedal force of approximately 73 pounds is applied to the directional anti-torque control pedals. The primary controls will then be free to operate as normal. When a separation occurs in the backup control system, the primary control continues to maintain the control function.

2-27. Force Trim.

The system incorporates a magnetic brake and force gradient in the cyclic control system to provide artificial feel into the system. Also, it provides a means to trim the cyclic control. Placing the FORCE TRIM release switch (figure 2-7) in the FORCE TRIM position will activate the system. Pressing the cyclic stick force trim switch (figure 2-5) will cause the magnetic brake and force gradient to be repositioned to correspond to the positions of the cyclic stick thus providing trim. The system is powered by the 28 Vdc essential bus and protected by the FORCE TRIM circuit breaker.

2-28. Horizontal Stabilizer.

The horizontal stabilizer (figure 2-1) is located near the center of the tail boom and is installed in a predetermined fixed position. The horizontal stabilizer aids in trimming the helicopter in level flight and increases usable C.G. range.

2-28.1. Vertical Fin.

The Vertical Fin is located to the right of the tail rotor and is installed in a predetermined fixed position.

Section VI. HYDRAULIC SYSTEM**2-29. Description.**

The hydraulic system consists of a variable delivery pump and reservoir, servo actuators with irreversible valve circuits for cyclic and collective controls, a pressure line filter, a return line filter, and a solenoid shutoff valve. The pump is located on the transmission. The hydraulic system provides for fully powered flight controls during autorotative flight.

2-30. Control.

The HYD BOOST switch (figure 2-7) is located in the lower right portion of the instrument panel and

controls the activation and deactivation of the hydraulic system. The system is powered by 28 Vdc and protected by HYD BOOST SOL circuit breaker.

2-31. Hydraulic Pressure Caution Light.

The HYD PRESS caution light (figure 2-15) is located in the caution panel and will illuminate when the hydraulic pressure is below normal. The caution light is powered by 28 Vdc and protected by CAUTION PNL LT circuit breaker.

Section VII. POWER TRAIN SYSTEM**2-32. Description.**

The system includes transmission, main driveshaft, freewheeling unit, tail rotor driveshafts, and tail rotor gearbox.

2-33. Transmission.

The transmission is mounted on the cabin roof deck, forward of the power plant. The transmission transfers engine power to the main rotor through the mast assembly. The tail rotor is driven through the freewheeling unit, tail rotor driveshafts and tail rotor gearbox. An oil level sight gage is located on the right side of the transmission case. A breather type filler cap and two electrical magnetic chip detector drain plugs are incorporated. The transmission also furnishes lubrication for the freewheeling unit mounted in the engine accessory gearbox. Transmission oil is cooled by the oil cooler blower.

2-33.1. Pylon Support Structure.

a. The OH-58 has a design feature called a focused pylon mounting system for its pylon. This support concept differs from conventional four or five point spring mounting arrangements as follows

(1) The pylon bi-pod supports aim or focus pylon input loads at the fuselage vertical center of gravity. The purpose is to reduce cabin vibration by eliminating pylon induced rolling moment about the center of gravity.

(2) Rigid mounting in the vertical plane minimizes vertical vibration.

(3) Vibration should not increase with mount aging as is possible with conventional spring mounted pylon supports.

(4) The elastomeric mount provides pylon static centering.

2-33.2. Pylon Suspension System.

a. The main transmission is supported and attached at its lower rear section by an isolation mount. Bolted to the lower aft part of the transmission case is the Drag Pin which bolts to the elastomeric isolation mount.

b. The drag pin has a metal pin which is commonly referred to as the spike. The drag pin or spike physically is mounted so that it "rides" inside the square metal opening of the transmission mount support.

c. The isolation mount is used to dampen pylon to fuselage vibrations and limit pylon rock. Movement of the transmission and isolation mount is limited by means of the drag pin (spike) which extends down into the transmission mount support mounted on the deck.

d. Contact between the drag pin and the transmission mount produces a noise known as spike knock.

2-34. Freewheeling Assembly.

The freewheeling unit is mounted in the accessory gearbox. Engine power is transmitted through the freewheeling unit to the main driveshaft and the tail rotor driveshafts to provide power to the main and tail rotors respectively. During autorotation the freewheeling unit provides engine disconnect and the transmission drives the tail rotor.

2-35. Tail Rotor Gearbox.

The gearbox is located near the vertical fin and provides a 90 degree change of direction of the tail rotor driveshaft. A breather type filler cap, electrical chip detector drain plug and an oil level sight gage are provided.

2-36. Driveshafts.

a. Main Driveshaft. The main driveshaft connects the engine output to the transmission.

b. Tail Rotor Driveshaft. The tail rotor driveshaft is made up of four sections; the forward short shaft, the oil cooler fan shaft, the aft short shaft, and the long shaft.

2-37. Indicators.

a. Transmission Chip Detectors. There are three chip detectors located within the transmission lubricating system. Two electrical chip detectors are located on the base of the transmission and are wired to the XMSN CHIP DET caution light. One magnetic chip detector is located on the freewheeling unit and is not connected to the caution lighting system. All three are provided to give evidence of ferrous metal particles in the transmission lubrication system.

b. Tail Rotor Gearbox Chip Detector. The chip detector is located in the lower section of the tail rotor gearbox. The chip detector is wired to the T/R CHIP DET caution light and the MASTER CAUTION light. The caution light is activated when a sufficient amount of metal particles has been collected on the chip detector to close the circuit.

c. Transmission Oil Pressure Warning Light. The XMSN OIL PRESS warning light (figure 2-15) is located in the upper right corner of the instrument panel. The XMSN OIL PRESS light will illuminate steady until oil pressure is above 30 psi. The transmission oil pressure switch is located on the left side of the cabin roof near the transmission. The light is protected by the CAUTION PNL LTS circuit breaker.

d. Transmission Oil Temperature Warning Light. The XMSN OIL HOT warning light (figure 2-7 and 2-15) is located in the upper right corner of the instrument panel. The XMSN OIL HOT light will illuminate steady until oil temperature is below 110°C. The transmission oil temperature sensor is located on the transmission oil filter head. The light is protected by the CAUTION PNL LTS circuit breaker.

e. Transmission Oil Pressure Indicator. The transmission oil pressure indicator (figure 2-7), located in the instrument panel displays transmission oil pressure PSI. The transmission oil pressure sensor is located adjacent to the transmission oil pressure switch. The indicator is powered by 28 Vdc and protected by the XMSN OIL PRESS circuit breaker.

Section VIII. MAIN AND TAIL ROTOR

2-38. Main Rotor.

The main rotor is driven by the mast which is connected to the transmission. The rotor rpm is governed by the engine rpm during powered flight. The rotor tip path plane is controlled by the cyclic stick. The rotor pitch is controlled by the collective lever.

2-39. Main Rotor RPM Indicator

The rotor tachometer indicator (figure 2-7) is part of PNL LTS circuit breaker and connections are made to the ROTOR RPM warning light and to a tone generator which provides an audible tone in the crew headsets. The ROTOR RPM light illuminates steady when the main rotor rpm drops below $95 \pm 1.4\%$. The circuit is powered by 28 Vdc

the dual tachometer. Refer to paragraph 2-19 f.

2-40. RPM Warning System.

A ROTOR RPM warning system is installed to provide a visual and audio indication of low rotor rpm. A RPM sensor is connected to the rotor tachometer generator. Power is supplied from the CAUTION and protected by the CAUTION PNL LT circuit breaker.

2-41. Tail Rotor.

The tail rotor is driven by the tail rotor gearbox. Tail rotor blade pitch is controlled by the anti-torque pedals.

Section IX. UTILITY SYSTEM

2-42. Pitot Tube Heating System.

The pitot tube (figure 2-1) is equipped with an electrical heater to prevent ice from forming in the pitot

tube. The circuit is powered by 28 Vdc and protected and controlled by a PITOT HTR (figure 2-8) circuit breaker switch located on the overhead console.

Section X. HEATING, DEFOGGING, AND VENTILATION

2-43. Heating, Defogging, and Ventilation Systems.

a. Bleed Air Heating System.

(1) *Description.* The bleed air heater is installed in the equipment compartment aft of the electrical shelf behind the passenger seat. A HTR circuit breaker switch (figure 2-8) located on the overhead console actuates the heater. The pilot may select air temperature by means of a HEAT control knob (figure 2-13) located above and aft of his head. This knob operates a control cable in the cabin roof to adjust an air temperature sensor mounted in the heater discharge duct. Adjusting the sensor mixes the fresh and bleed air to obtain the air temperature selected by the pilot.

(2) Operation.

- (a) HTR switch — HTR.
- (b) HEAT control — Adjust as desired.

b. Bleed Air Defogging System.

(1) *Description.* The bleed air heating ducts are connected to windshield defog nozzles at the bottom of the forward windshield through blowers mounted in the fuselage nose. The blowers are activated by DEFOG & VENT circuit breaker switch (figure 2-8)

located on the overhead console to increase airflow velocity over the windshield. Lower nose window defog is continuous and automatic when HTR switch is turned on.

(2) Operation.

- (a) HTR switch — HTR.
- (b) DEFOG & VENT switch — DEFOG & VENT.
- (c) HEAT control — Adjust as desired.
- (d) Outlets and vents — As desired.

c. Fresh Air Ventilation and Fresh Air Defogging.

(1) *Description.* Outside fresh air from an intake on the top of the fuselage nose is directed through the windshield defog nozzles mounted on the lower windshield frame. A VENT PULL control on the right side of the instrument panel (figure 2-7 and 2-13) opens and closes the fresh air intake. Refer to preceding step a. For blower description.

(2) Operation.

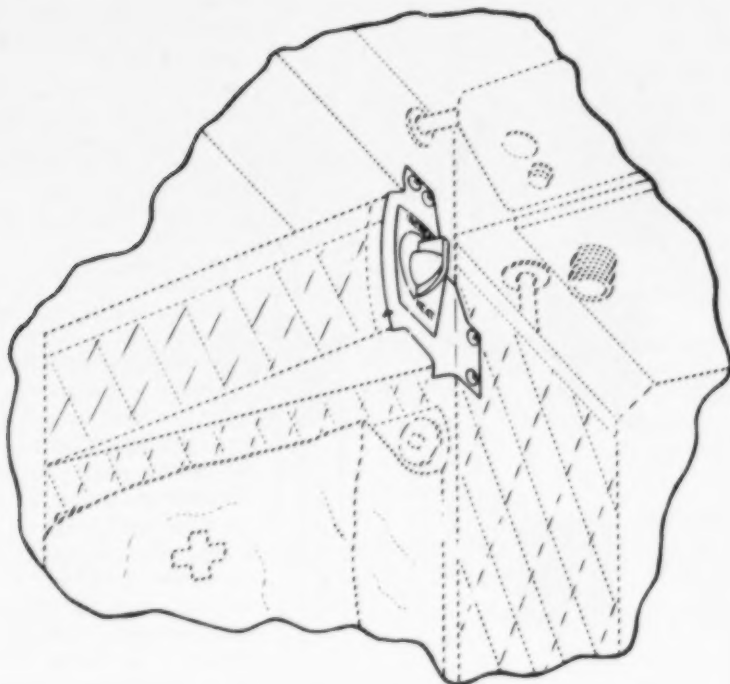
- (a) VENT PULL control — As desired.
- (b) DEFOG & VENT switch — As desired.

Section XI. ELECTRICAL POWER SUPPLY AND DISTRIBUTION SYSTEM

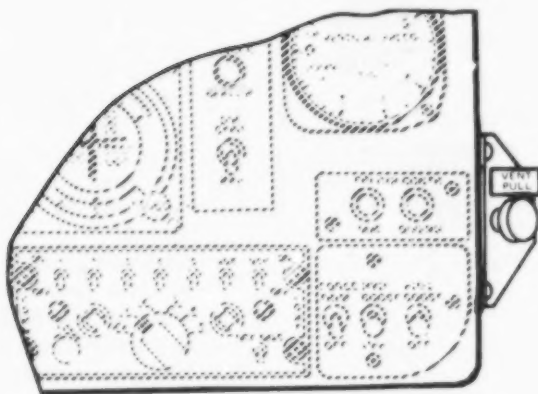
2-44. Direct Current Primary Power.

The helicopter is equipped with a 28 Vdc dual bus

(essential and non-essential) system supplied by a starter-generator and battery (figure 2-11 and 2-14). In the event of generator failure, the non-essential bus



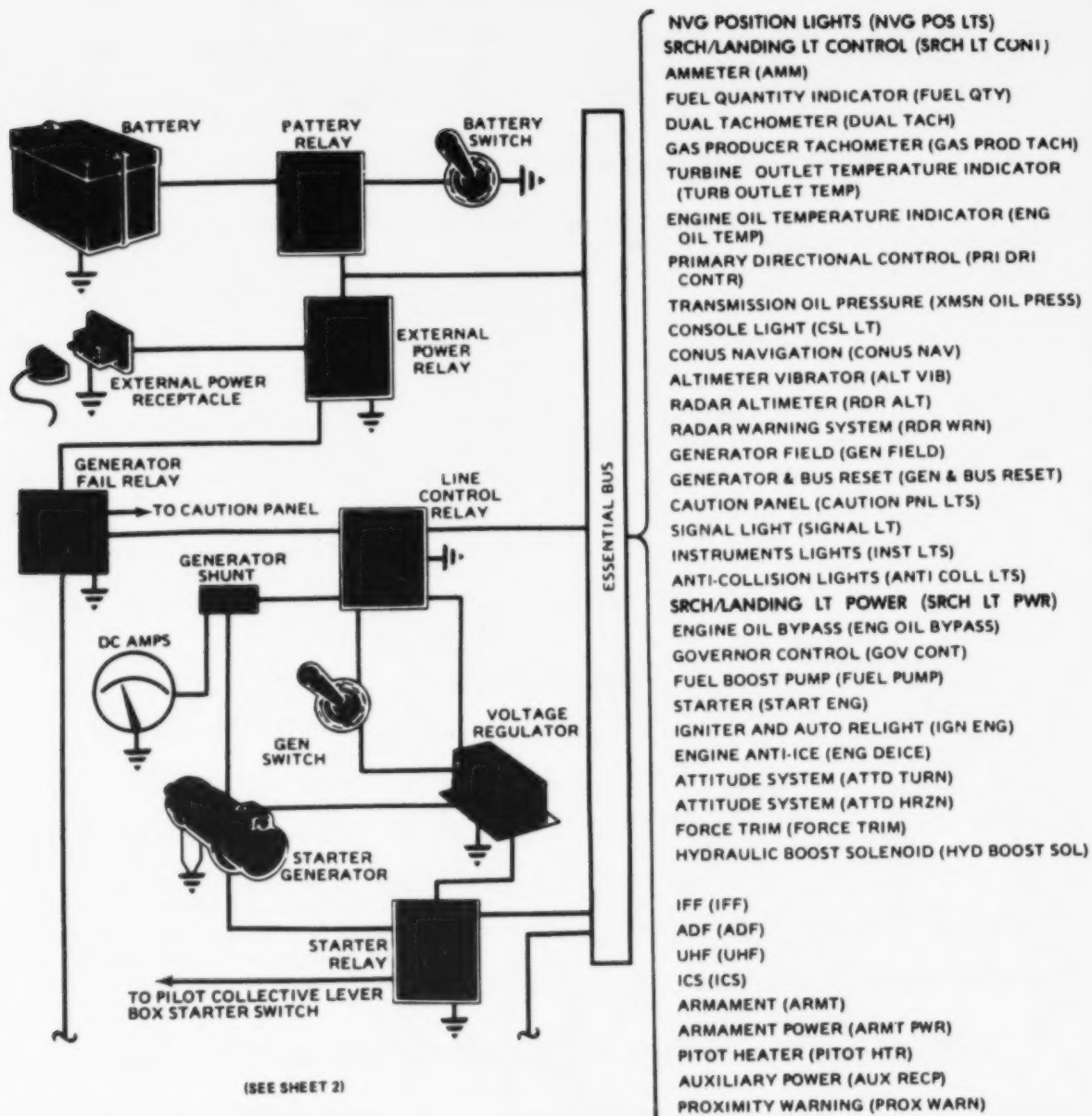
HEATER CONTROL KNOB



VENT PULL CONTROL KNOB

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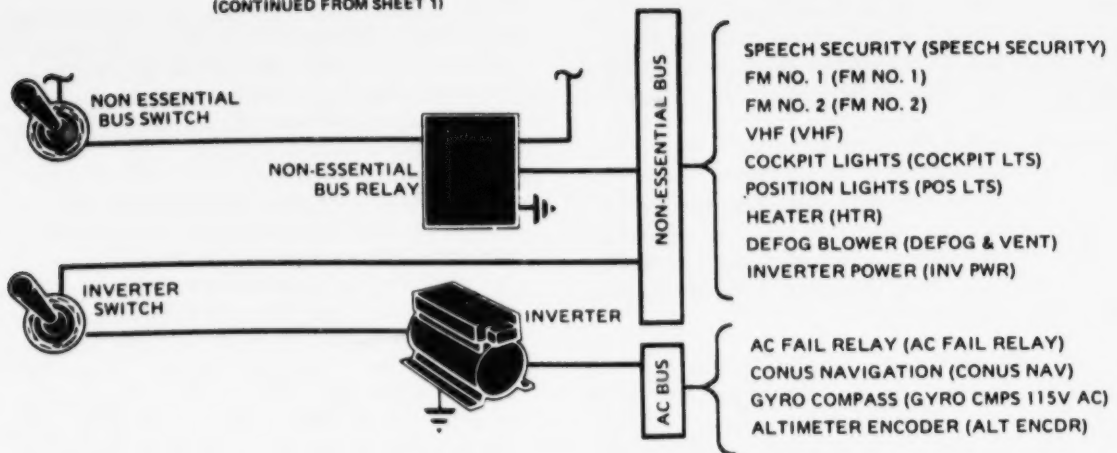
Figure 2-13. Heater control and vent pull knobs



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Figure 2-14. Electrical system schematic (Sheet 1 of 2)

(CONTINUED FROM SHEET 1)



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Figure 2-14. Electrical system schematic. (Sheet 2 of 2)

is automatically deactivated when the NON-ESS BUS switch is in the NORM position. The battery then supplies power to the essential bus load. The nonessential bus will remain activated with the NON-ESS BUS switch in the MAN position. The battery then provides power to both busses. In the event of engine failure, generator power will be lost.

a. Indicators and Controls.

(1) *DC ammeter indicator.* The ammeter (figure 2-7) is mounted in the instrument panel and displays the output of the starter generator. The circuit is protected by two circuit breakers on the aft electrical shelf.

(2) *DC power control.* The dc power is controlled by the BAT switch, GEN switch, and NON-ESS BUS switch. The system is protected by GEN & BUS RESET and GEN FIELD circuit breakers (figure 2-8).

(a) *Battery switch.* The BAT switch (figure 2-8) is located on the overhead console and is a two-position toggle switch, labeled BAT and OFF. Battery electrical power is supplied to the essential bus when the switch is in the BAT position.

(b) *Generator switch.* The GEN switch (figure 2-8) is located on the overhead console and is a three position switch. The switch is labeled GEN in the forward position, OFF in the center position, and RESET in the aft position. The RESET position is spring loaded to return to the OFF position when released. To reset the generator the switch must be held in the RESET position momentarily and then moved to the forward position. The OFF position isolates the generator from the system. The circuit is powered by 28Vdc and is protected by the GEN & BUS RESET and GEN FIELD circuit breakers.

(c) *Nonessential bus switch.* The NON-ESS BUS switch (figure 2-8) is located on the overhead console. When the switch is in the NORM position, power is supplied to the nonessential bus when the generator is operating or when external power is applied. When the switch is in the MAN position

power is supplied to the nonessential bus regardless of generator operation.

(3) *Circuit Breakers.* The dc circuit breakers (figure 2-8) are located in the overhead console and the electrical shelf. The breakers will deactivate automatically in the event of a circuit overload. Each breaker is labeled for the particular circuit it protects.

(4) *External Power Receptacle.* During ground operations external power may be connected to the electrical system through an external power receptacle (figure 2-1) located on the lower right side of the helicopter. The GEN and BAT switches should be in the OFF position when external power is connected. The external power relay closes automatically and connects the ground unit to the essential and nonessential buses. A GPU power of 300 to 750 amperes and 28 Vdc is recommended.

(5) *Auxiliary Power Receptacle.* The auxiliary power receptacle is mounted on a bulkhead aft of the copilot seat and provides power take off of 28 Vdc to operate miscellaneous auxiliary equipment. The circuit is powered by 28 Vdc essential bus and is controlled and protected by AUX RECP circuit breaker switch on the overhead console.

2-45. Alternating Current Power Supply.

The helicopter is equipped with a solid state inverter powered from the nonessential 28 Vdc bus, protected by INV PWR circuit breaker, and manually controlled by an INV switch (figure 2-8). The inverter delivers 115 VAC, 400 Hz to the ac bus. An INST INVERTER caution light (figure 2-15) will illuminate when ac power is off.

a. *Inverter Switch.* The INV switch (figure 2-8) is located on the overhead console and is a two-position toggle switch labeled INV and OFF. AC electrical power is provided to the electrical system when the switch is in the INV position.

b. *Circuit Breakers.* The ac circuit breakers are located on the overhead console (figure 2-8).

Section XII. LIGHTING

2-46. Position Lights.

a. *Standard Position (Navigation) Lights.* The standard position lights consist of three lights (figure 2-1). A green light is located on the right

horizontal stabilizer tip, a red light on the left horizontal stabilizer tip, and a white light on the aft end of the tailboom. Power is supplied by the 28-volt DC nonessential bus. Circuit protection is

provided by the POS LTS circuit breaker on the overhead console (figure 2-8). The position lights are controlled by the POS LTS switch on the overhead console. The switch is a three-position toggle switch with BRT (forward), DIM (center), and OFF (aft) positions.

b. NVG Position Lights. Five, white IR position lights (NVG position lights) are mounted on the aircraft. Two forward NVG position lights (55, figure 2-1) are mounted forward of the FM homing antenna on both sides of the aircraft. Two lower

NVG position lights (55, figure 2-1) are mounted forward of the APR-39 antenna support. One aft NVG position light is located on top of the tail light support assembly. Power for NVG position lights is provided by the NVG POS LTS circuit breaker (55, figure 2-1). Operation of the NVG position lights is controlled by a five-position rotary switch, NVG POS LTS, (figure 2-8) located on the overhead console. In position 1, the lights are at minimum intensity, in position BRT, the lights are at maximum intensity.

2-47. Anti-Collision Lights.

The anti-collision lights (figure 2-1) are located one on top of the engine cowling and one centered at the lower section of the fuselage aft of the avionics compartment. Power for the lights is supplied by 28 Vdc essential bus and protected by ANTI COLL LTS circuit breaker. The ANTI COLLISION LTS switch (figure 2-8) is located on the overhead console. The switch is a two-position toggle type labeled ANTI COLLISION LTS and OFF.

2-48. IR/White (Dual) Landing/Searchlight.

A dual light assembly with a white light on one side and IR light on the other side is mounted in the lower nose section of the helicopter (28, figure 2-1). Power for the light assembly is provided by the SRCH LT CONT and SRCH LT PWR circuit breakers. One three-position switch and one four-position switch, co-located on the pilot's collective lever (figure 2-6), are used to operate the light assembly. The three-position switch LDG LT (ON-OFF-NVG) controls illumination of the white light (ON position) and the IR light (NVG position). The four-position switch LDG LT (EXT-RETR-L-R) provides extension, 360° rotation and retraction.

NOTE

White light will automatically extinguish when light rotates 90° right or left of center, if extended less than 60°.

CAUTION

Do not illuminate IR light with light assembly fully retracted.

2-49. Instrument Lights.

NVG-compatible bezel lights and postlights provide instrument panel lighting (figure 2-7). The instrument panel lighting is controlled by the INST LT rheostat control (figure 2-8) and is powered by the INST LTS circuit breaker.

2-50. Console Lights.

NVG-compatible panel lights provide lighting of the ICS boxes KY28 and the ADF REVR located in the aircraft. The console lighting is controlled by the CONSOLE LT rheostat (figure 2-8) and is powered by the CSL LT circuit breaker.

2-51. Signal Light Receptacle.

A plug in type receptacle (figure 2-8) for a hand held signal light is located at the aft end of the overhead console. The circuit is powered by 28 Vdc essential bus and protected by SIGNAL LT circuit breaker.

2-52. Utility Light and Floodlights.

Supplementary NVG-compatible cockpit lighting is provided by a utility light and three floodlights. The utility light is attached to a flexible gooseneck extension mounted on the centerpost between the pilot and copilot seats (figure 2-7). The flexible gooseneck holds the utility light in the position selected by the pilot or copilot. An extension cord allows removal of the utility light from the gooseneck for manual use. The light is equipped with a self-contained rheostat and has a rheostat override pushbutton that provides full lamp output regardless of knob setting. Power for the light is provided by the COCKPIT LTS circuit breaker. Three NVG-compatible floodlights are mounted on the glareshield (figure 2-7). Floodlight intensity is controlled by the CONSOLE LT rheostat. The floodlights are powered by CSL LTS circuit breaker (figure 2-8).

2-53. NVG-Compatible Filters.

NVG-compatible flip filters are mounted next to the master caution, caution advisory, RPM and radar warning indicators (figure 2-7). The filters are positioned closed for NVG flight only.

WARNING

NVG-compatible flip filters are to remain in the open position (unfiltered during day flight and night flight without night vision goggles).

Section XIII. FLIGHT INSTRUMENTS

2-54. Airspeed Indicator.

The airspeed indicator (figure 2-7) displays the air speed of the helicopter indicated in knots. The airspeed is obtained by measuring the difference between impact air pressure from the pitot tube and the static air pressure from the static ports.

2-55. AAU-31/A Pneumatic Altimeter.

a. Description. The AAU-31/A pneumatic counter-drum-pointer altimeter is a precision pressure altimeter (figure 2-7). Pressure altitude is displayed by a 100-foot drum and a single pointer indicating hundreds of feet on a circular scale, with 50' center markings. Below an altitude of 10,000 feet, a diagonal warning symbol will appear on the 10,000-foot counter.

A barometric pressure setting knob is provided to insert the desired altimeter setting in inches of Hg. A DC powered vibrator operates inside the altimeter whenever aircraft power is on.

b. Operation.

(1) Normal operation. The ALTVIB circuit breaker must be in. The altimeter indicates pneumatic altitude reference to the barometric pressure level as selected by the pilot. A vibrator, powered by the DC essential bus, is contained in the altimeter and requires a minimum of one minute warmup prior to checking or setting the altimeter.

(2) Abnormal operation. If the altimeter's internal vibrator becomes inoperative due to internal failure or DC power failure, the pointer and drum may momentarily hang up when passing from "9" through "0" (climbing) or from "0" through "9" (descending). This hang-up will cause lag, the magnitude of which will depend on the vertical velocity of the aircraft and the friction in the altimeter. Pilots should be especially watchful for this type failure when the minimum approach altitude lies within the "8" - "1" part of the scale (800-1100, 1800-2100, etc).

2-56. Attitude Indicator.

The attitude indicator (figure 2-7) displays the helicopter pitch and roll attitudes in relation to the earth horizon. Pitch attitude is displayed by the motion of the sphere with respect to the miniature airplane. Roll attitude is displayed by the motion of the roll pointer with respect to the fixed roll scale. The sphere can be adjusted to zero indication by the pitch trim knob. The rate of turn pointer indicates in which direction and at what rate the helicopter is turning. The inclinometer indicates when the helicopter is in trim, either in a

coordinated turn or in straight and level flight. The warning flag, attitude (ATT) and rate of turn pointer provide indication of system malfunctions. When the gyro is being caged or when 28 Vdc power is interrupted, the ATT flag will be in full view. The rate of turn pointer will be biased out of view when 28 Vdc is interrupted. The circuit is powered by 28 Vdc essential bus and protected by ATTD HRZN and ATTD TURN circuit breakers. The rate-of-turn pointer is driven by 115 VAC internal circuitry that derives rate-of-turn from the output synchro transmitter of the directional gyro magnetic compass.

2-57. Vertical Speed Indicator.

The vertical speed indicator (figure 2-7) displays the helicopter ascent and descent speed in feet per minute. The indicator is actuated by the rate of atmospheric pressure change.

2-58. Free Air Temperature (FAT) Indicator.

The free air temperature indicator (figure 2-4) displays the outside air temperature in Celsius degrees.

2-59. Magnetic Compass.

The magnetic compass (figure 2-4) displays the magnetic heading of the helicopter. A compass correction card is attached to a duct below and aft of the compass. In aircraft painted with low reflective interiors the compass correction card will be located in the aircraft logbook.

2-60. CONUS Navigation System (AN/ARN-123)

Refer to Chapter 3.

2-61. Radar Altimeter (AN/APN-209).

Refer to Chapter 3.

2-62. Radar Warning System.

Refer to Chapter 3.

2-63. Clock.

The clock (figure 2-7) has a sweep-second pointer and a minute totalizer hand to indicate elapsed time.

2-64. Warning Light System.

a. Warning System. The warning system consists of five individually illuminated warning light segments mounted in the MASTER CAUTION and warning light panel (figure 2-15) on the instrument panel. The purpose of this system is to provide visual indication for day or night operation that any of the five conditions or combinations thereof has occurred. Each fault condition as it occurs is indicated by a steady illumination of the lettering on the particular segment. In addition, an audio signal sounds when the ENGINE OUT or ROTOR RPM segment is illuminated and the collective pitch is not in the full down position. The warning indicator segment remains illuminated until the fault condition is corrected.

ENGINE OUT	Engine N1 speed below 55 ± 3%.
XMSN OIL PRESS	Transmission oil pressure dangerously low
XMSN OIL HOT	Transmission dangerous- ly hot
ROTOR RPM	Rotor rpm low
MASTER CAUTION	Fault condition in cau- tion panel.

b. Warning Lights Test Switch. The WARNING LTS TEST switch (figure 2-7) is pressed to check for illumination of all the warning lights.

2-65. Caution Panel Light Systems.

a. Caution System. The caution system is a segment wording type, consisting of a segment word

warning CAUTION panel (figure 2-15) on the lower console and remote MASTER CAUTION segment on the instrument panel. The purpose of the CAUTION system is to provide visual indication suitable for day or night operation, that a fault condition has occurred. In addition, a positive signal is provided to illuminate the remote MASTER CAUTION indicator. Each fault condition, as it occurs, is indicated by flashing of the lettering on the segment involved and by illumination of the MASTER CAUTION indicator.

b. Test/Reset Switch. The TEST/RESET switch (figure 2-15) is positioned to TEST to check if all caution lights are operational. Testing of the system will not change the existing fault condition indications. Momentarily placing the switch in the RESET position will extinguish and reset the MASTER CAUTION light so it will illuminate again should another fault condition occur. The fault segment will be steadily ON. Segments will remain lighted as long as the fault condition(s) exist.

c. Bright-Dim Switch. The BRIGHT-DIM switch (figure 2-15) controls the brightness of the caution panel lights and the MASTER CAUTION light. The INST LTS switch must be moved from the DIM position before the caution panel lights can be dimmed. The system is so designed that after each initial application of power, the lamps will illuminate in the bright condition.

Section XIV. SERVICING, PARKING, AND MOORING**2-66. Servicing.**

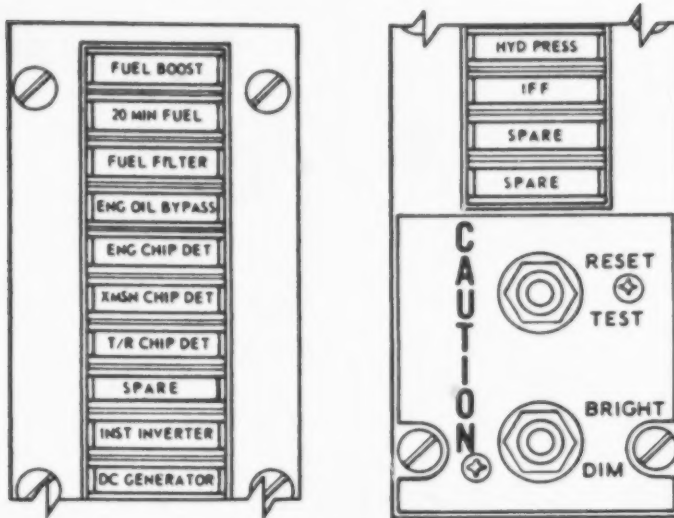
- Servicing Diagram.** Refer to figure 2-16.
- Fuels, Oils, Fluids and Unit Capacities.** Refer to table 2-1.

2-67. Approved Fuels, Oils, and Fluids.

- Fuels.** Refer to table 2-2.
- Oils.** Refer to table 2-3.
- Fluids.** Refer to table 2-4.



WARNING PANEL

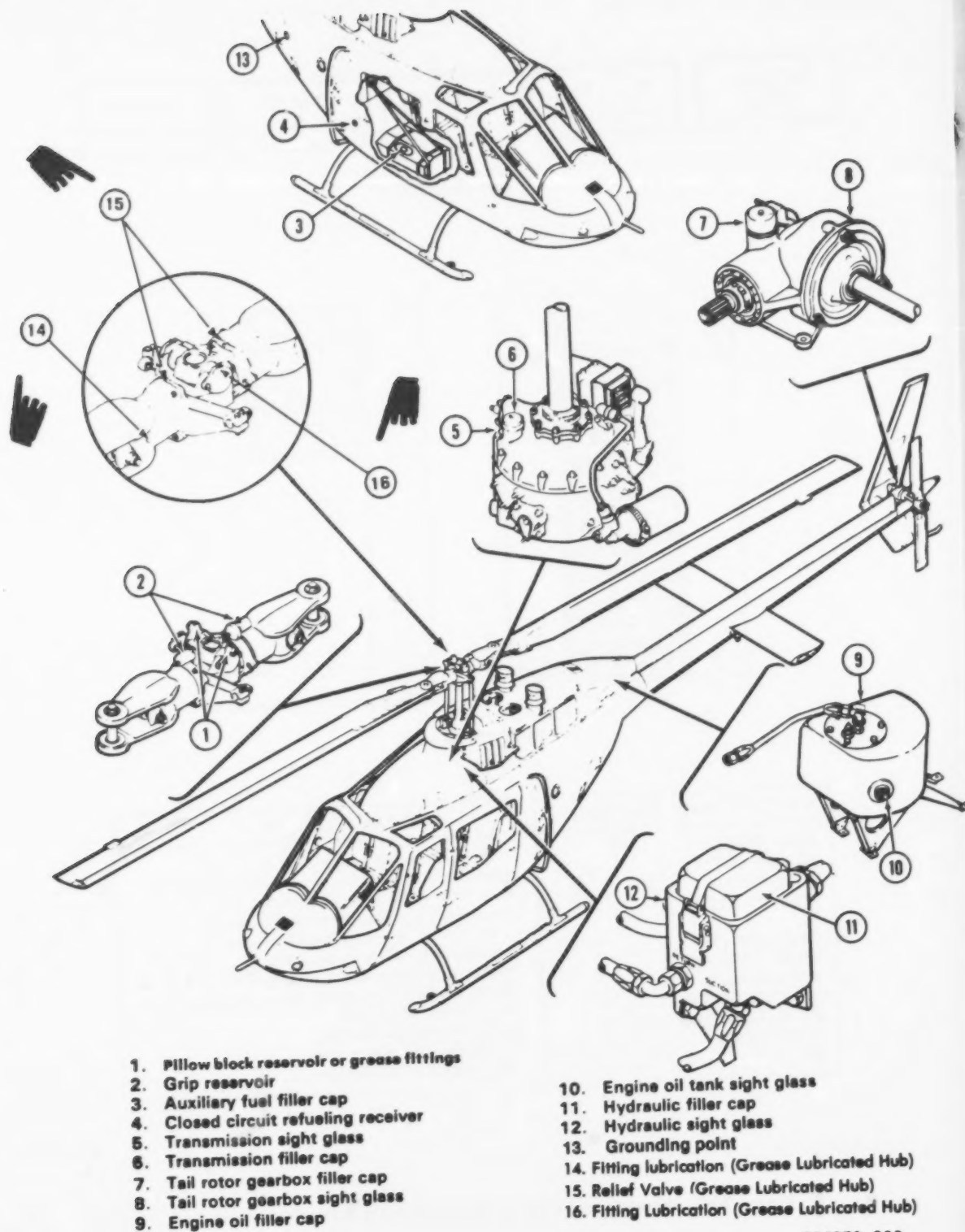


CAUTION PANEL

CAUTION PANEL WORDING	FAULT CONDITIONS
FUEL BOOST 20 MIN FUEL FUEL FILTER ENG OIL BYPASS ENG CHIP DET XMSN CHIP DET T/R CHIP DET INST INVERTER DC GENERATOR HYD PRESS IFF	Fuel boost pump pressure is low. Fuel quantity is below approximately 65 to 80 lbs Fuel filter is partially obstructed. Engine oil is at dangerously low level and/or oil is bypassing oil cooler. Metal particles are in engine. Metal particles are in transmission. Metal particles are in tail rotor gearbox. Ac inverter has failed. Dc generator has failed. Hydraulic pressure is low. IFF system is inoperative.

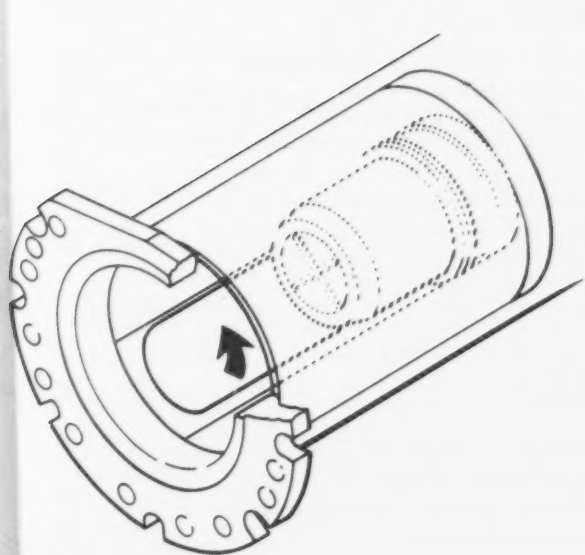
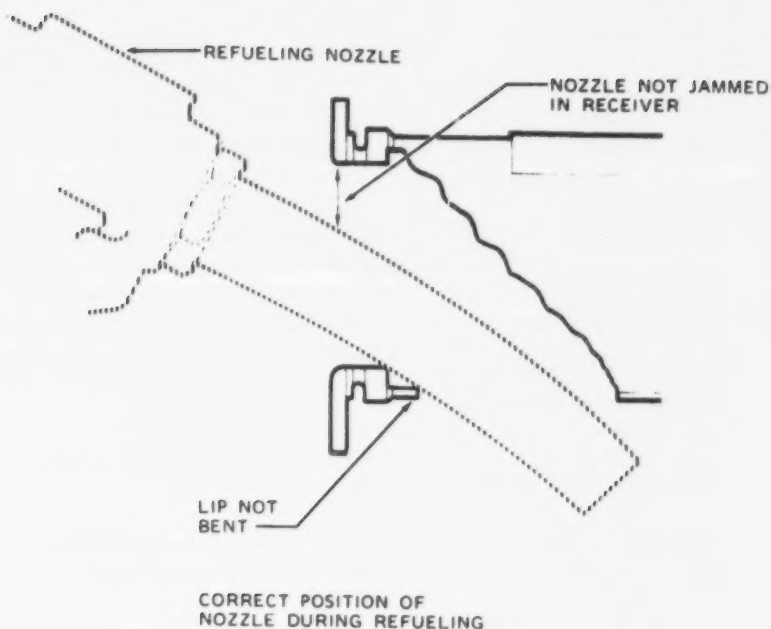
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Figure 2-15. Warning and Caution Panels with NVG Flip Filters Installed.

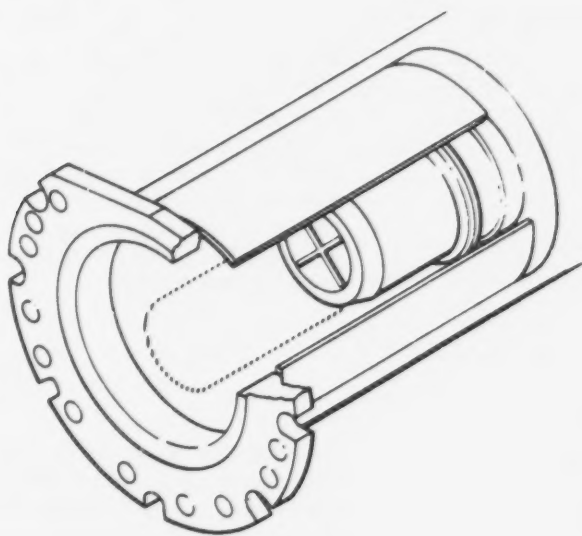


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Figure 2-16. Servicing diagram. (Sheet 1 of 2)



SLEEVE POSITION WHEN USING GRAVITY REFUELING SYSTEM



SLEEVE POSITION WHEN USING CLOSED CIRCUIT REFUELING SYSTEM

206075-41

Figure 2-16. Servicing diagram (Sheet 2 of 2)

Table 2-1. Fuels, Oils, Fluids, Specification and Capacities

SYSTEM	SPECIFICATION	NOTE	CAPACITY
Fuel	MIL-T-5624 (JP-4)	1	71.5 U.S. Gals Total 70.3 U.S. Gals Usable
Engine Oil	*MIL-L-7808 MIL-L-23699	2,4 3,4	11.2 U.S. Pints (1.4 U.S. Gals)
Transmission Oil	*MIL-L-7808 MIL-L-23699	2,4 3,4	8 U.S. Pints
Tail Rotor Gearbox Oil	*MIL-L-7808 MIL-L-23699	2,4 3,4	0.375 U.S. Pints
Main Rotor Reservoir	MIL-L-2104, Grade 30 Alt.-SAE30 Motor Oil HD		4.0 U.S. Pints
Hydraulic Fluid System	MIL-H-5606 MIL-H-83282	5,6,7 6,7	2.25 U.S. Pints
Hydraulic Fluid Reservoir	MIL-H-5606 MIL-H-83282	5,6,7 6,7	1.375 U.S. Pints

WARNING

Prolonged contact with hydraulic fluid (MIL-H-83282) liquid or mist can irritate eyes and skin. After any prolonged contact with skin, immediately wash contacted area with soap and water. If liquid contacts eyes, flush immediately with clear water. If liquid is swallowed, do not induce vomiting; get immediate medical attention. Wear rubber gloves when handling liquid. If prolonged contact with mist is likely, wear an appropriate respirator. When fluid is decomposed by heating, toxic gases are released.

CAUTION

*Lubrication oil made to MIL-L-7808 by Shell Oil Company under their part number 307, qualification number 7D-1, shall not be used in OH-58 engine or aircraft systems. It contains additives which are harmful to seals in the systems.

Table 2-1. Fuels, Oils, Fluids, Specification and Capacities (Continued)**NOTE:**

1. MIL-T-5624 (JP-4) NATO code is F-40.
Alternate fuel is MIL-T-5624 (JP-5) (NATO F-44).
Emergency fuel is MIL-G-5572 (Any AV gas) (NATO F-12, F-18, F-22).
2. MIL-L-7808 NATO code is 0-148.
For use in ambient temperatures below minus 32°C/25°F.
May be used when MIL-L-23699 oil is not available.
3. MIL-L-23699 NATO code is 0-156.
For use in ambient temperatures above minus 32°C/25°F.

CAUTION

Under no circumstances shall MIL-L-23699 oil be used in ambient temperatures below minus 32°C/25°F.

4. It is not advisable to mix MIL-L-7808 and MIL-L-23699 oils, except during an emergency. If the oils are mixed, the system shall be flushed within six hours and filled with the proper oil. An entry on DA Form 2408-13 is required when the oils are mixed.
 5. MIL-H-5606 NATO code is H-515.
For use in ambient temperatures below minus 40°C/40°F.
 6. For use in ambient temperatures above minus 40°C/40°F.
 7. It is not advisable to mix MIL-H-5606 and MIL-H-83282 fluids, except during an emergency. An entry on DA Form 2408-13 is required when the fluids are mixed. When changing from MIL-H-5606 to MIL-H-83282, not more than two percent of MIL-H-5606 may be present in the system.
-

Table 2-2. Approved Fuels

SOURCE	PRIMARY OR STANDARD FUEL	ALTERNATE FUEL	
US MILITARY FUEL NATO CODE NO.	JP-4 (MIL-T-5624) F-40 (WIDE CUT TYPE)	JP-5 (MIL-T-5624) or JP-8 (MIL-T-83133) F-44 or F-34 (High Flash Type)	
American Oil Co.	American JP-4	American Type A	Arcojet A-1
Atlantic Richfield	Arcojet B	Arcojet A	Richfield A-1
Richfield Div		Richfield A	B.P.A.T.K.
B.P. Trading	B.P.A.T.G.		Caltex Jet A-1
Caltex Petroleum Corp.	Caltex Jet B		
Cities Service Co.		CITGO A	Conoco Jet-60
Continental Oil Co.	Conoco JP-4	Conoco Jet-50	Gulf Jet A-1
Gulf Oil	Gulf Jet B	Gulf Jet A	EXXON A-1
EXXON Co. USA	EXXON Turbo Fuel B	EXXON A	Mobil Jet A-1
Mobil Oil	Mobil Jet B	Mobil Jet A	
Phillips Petroleum	Philjet JP-4	Philjet A-50	
Shell Oil	Aeroshell JP-4	Aeroshell 640	Aeroshell 650
Sinclair		Superjet A	Superjet A-1
Standard Oil Co		Jet A Kerosine	Jet A-1 Kerosine
Chevron	Chevron B	Chevron A-50	Chevron A-1
Texaco	Texaco Avjet B	Avjet A	Avjet A-1
Union Oil	Union JP-4	76 Turbine Fuel	

APPROVED FOREIGN COMMERCIAL FUELS

FOREIGN FUEL	NATO F-40	NATO F-44
Belgium	BA-PF-2B	3-6P-24e
Canada	3GP-22F	
Denmark	JP-4 MIL-T-5624	
France	Air 3407A	
Germany (West)	VTL-9130-006	UTL-9130-007/UTL 9130-010
Greece	JP-4 MIL-T-5624	
Italy	AA-M-C-1421	AMC-143
Netherlands	JP-4 MIL-T-5624	D. Eng RD 2493
Norway	JP-4 MIL-T-5624	
Portugal	JP-4 MIL-T-5624	
Turkey	JP-4 MIL-T-5624	
United Kingdom (Britain)	D. Eng RD 2454	D. Eng RD 2498

NOTE

Anti-icing and Biocidal Additive for Commercial Turbine Engine Fuel — The fuel system icing inhibitor shall conform to MIL-I-27686. The additive provides anti-icing protection and also functions as a biocide to kill microbial growths in aircraft fuel systems. Icing inhibitor conforming to MIL-I-27686 shall be added to commercial fuel, not containing an icing inhibitor, during refueling operations, regardless of ambient temperatures. Refueling operations shall be accomplished in accordance with accepted commercial procedures. This additive (prist or eq.) is not available in the Army Supply System, but will be locally procured when needed.

Table 2-3. Approved Oils**APPROVED COMMERCIAL MIL-L-7808 TYPE OILS**

MANUFACTURER'S NAME	MANUFACTURER'S DESIGNATION
American Oil and Supply Co.	PQ Turbine Oil 8365
Humble Oil and Refining Co.	ESSO/ENCO Turbo Oil 2389
Mobile Oil Corp.	RM-184A/RM-201A

CAUTION

Do not use Shell Oil Co., part No. 307, qualification No. 7D-1 oil (MIL-L-7808). It can be harmful to seals made of silicone.

APPROVED COMMERCIAL MIL-L-23699 TYPE OILS

MANUFACTURER'S NAME	MANUFACTURER'S DESIGNATION
American Oil and Supply Co.	PQ Turbine Lubricant 5247/ 6423/6700/7731/8878/9595
Bray Oil Co.	Brayco 899/899-G/899-S
Castrol Oil Inc.	Castrol 205
Chevron International Oil Co., Inc.	Jet Engine Oil 5
Crew Chemical Corp.	STO-21919/STO-21919A/STD 6530
W. R. Grace and Co. (Hateco Chemical Div.)	HATCOL 3211/3611
Exxon	Turbo Oil 2380 (WS-6000)/2395 (WS-6459)/2392/2393
Mobile Oil Corp.	RM-139A/RM-147A/Avrex S Turbo 260/Avrex S Turbo 265
Royal Lubricants Co.	Royco 899 (C-915)/899SC/ Stauffer Jet II
Shell Oil Co., Inc.	Aeroshell Turbine Oil 500
Shell International Petroleum Co., Ltd.	Aeroshell Turbine Oil 550
Standard Oil Co., of California	Chevron Jet Engine Oil 5
Stauffer Chemical Co.	Stauffer 6924/Jet II
Texaco, Inc.	SATO 7377/7730. TL-8090

Table 2-4. Approved Fluids

APPROVED COMMERCIAL MIL-H-5606 TYPE FLUIDS	
MANUFACTURER'S NAME	MANUFACTURER'S DESIGNATION
American Oil and Supply Co.	"PO" 4226
Bray Oil Co.	Bryco 757B Brayco 756C Brayco 756D
Castrol Oils, Inc.	Hyspin A
Humble Oil and Refining Co.	Univis J41
Mobile Oil Corp.	Aero HFB
Pennsylvania Refining Co.	Petrofluid 5606B Petrofluid 4607
Royal Lubricants Co.	Royco 756C/D DS-437
Shell Oil Co.	XSL 7828
Standard Oil Co., of California	PED 3565 PED 3337
Texaco, Inc.	TL-5874
Stauffer Chemical Co.	Aero Hydroil 500
Union Carbide Chemical Co.	YT-283
Union Carbide Corp.	FP-221

APPROVED COMMERCIAL MIL-H-83282 TYPE FLUIDS

MANUFACTURER'S NAME

MANUFACTURER'S DESIGNATION

Bray Oil Co.	Micronic 882
Royal Lubricants Co.	Royco 782
Hanover Processing Co.	Hanover R-2 HF 832
Gulf Oil Chemicals Co.	TS 741
Penreco	Petrofluid 822
Shell International Petroleum Co.	Aeroshell Fluid 31
American Oil and Supply Co.	PQ 3883 PQ 4219 PQ 4268 PQ 4362C PQ 4401
Nyco S.A.	Hydraunycoil FH2
Emery Industries, Inc.	Emery 2946
Hatco Chemical Co.	Hatcol 4283

WARNING

Prolonged contact with hydraulic fluid (MIL-H-83282) liquid or mist can irritate eyes and skin. After any prolonged contact with skin, immediately wash contacted area with soap and water. If liquid contacts eyes, flush immediately with clear water. If liquid is swallowed, do not induce vomiting; get immediate medical attention. Wear rubber gloves when handling liquid. If prolonged contact with mist is likely, wear an appropriate respirator. When fluid is decomposed by heating, toxic gases are released.

NOTE

Mixing of hydraulic fluids is authorized only in emergency situations. An entry in the remarks section of DA Form 2408-13 is required.

2-68. Types and Use of Fuels.**a. Fuel Types.**

(1) Standard Fuel. JP-4 is designated as the Army standard fuel to be used in this helicopter. JP-4 contains icing inhibitor blended at the refinery. Commercial Jet B is a JP-4 type fuel; its mixture might or might not contain icing inhibitor.

(2) Alternate Fuel. JP-5 and JP-8 are designated as the alternate fuel to be used in this helicopter. JP-5 and JP-8 contain icing inhibitor blended at the refinery. Jet A and Jet A1 are fuels without icing inhibitor.

(3) Emergency Fuel. Aviation gasolines (MIL-G-5572) without Tricresyl Phosphate (TCP) are designated as the emergency fuels to be used in this helicopter.

b. Use of Fuels.

(1) No restrictions are imposed on the use of JP-4.

(2) JP-5 and JP-8 type fuels may be added to JP-4 type fuels in any quantity in the helicopter fuel tank.

(3) Aviation gasoline may also added to turbine engine fuels in any quantity in the helicopter fuel tank. A fuel mixture which contains over 10 percent leaded gasoline shall be recorded as all leaded gasoline on DA Form 2408-13.

(4) Refer to paragraph 5-10 for fuel operation limits when alternate and emergency fuels are used.

2-69. Fuel System Servicing.

General. The fuel supply system consists of the fuel cell, fuel pump and lines.

a. Precautions in Fuel Servicing and Defueling.

(1) Position auxiliary ground power units on the windward side of the helicopter. Not required during hot refueling.

(2) Do NOT fuel or defuel during electrical storms.

(3) Do not fuel or defuel while ground radar sets are operating within 300 feet of the helicopter.

(4) Servicing personnel shall not wear metal taps on their shoes.

(5) Be sure battery switch is in OFF position and external power is disconnected before fueling or defueling the helicopter. Not required during hot refueling.

(6) Ground the helicopter at the receptacle located adjacent to the filler cap on right side of helicopter to the filler-nozzle before removing filler cap.

(7) Servicing vehicle shall be grounded (servicing vehicle to ground and servicing vehicle to helicopter). The helicopter shall be grounded to the same ground point as is the servicing vehicle.

(8) After completion of servicing, wash down and remove any spillover of jet fuel. This fuel does not evaporate as rapidly as gasoline, and constitutes a fire hazard for a much longer time. Cleaning materials or clothing which have become saturated with jet fuel shall be disposed of well away from the helicopter or hangar.

b. Before Hot Refueling (Rotors turning).

(1) Throttle — Idle.

(2) Force trim on or controls frictioned.

WARNING

In case of aircraft fire, observe fire emergency procedures in Chapter 9. DO NOT attempt to fly the aircraft. RAPID hot refueling shall only be accomplished using closed circuit refueling system.

(3) During hot refueling:

(a) Pilot will remain at the controls during refueling.

(b) A crew member, if available, should observe the refueling operation (performed by authorized refueling personnel) and stand fire guard as required.

(c) Passengers shall remain clear of the aircraft during the refueling operation.

(d) NO SMOKING during refueling operations.

(4) Refuel refer to paragraph 2-69a, c, and d.

(5) After hot refueling. The pilot shall be advised by the refueling crew that fuel cap(s) are secure and ground cables have been removed.

c. Servicing.

CAUTION

Internal fuel cell hoses and clamps can be jarred loose with fuel nozzles. Insert nozzle carefully in a generally downward direction, avoiding contact with internal fuel hoses. Fuel nozzles must be hand held during servicing.

- (1) Fill tank cells with specified fuel.

WARNING

In the event of major spillage of fuel, all powered equipment will be shut down. All personnel will leave the vicinity and be positioned to prevent any sources of possible ignition from entering area. The fire department will be summoned to the area to render safety.

- (2) Refer to table 2-1 for fuel tank capacity.

CAUTION

The closed circuit refueling receptacle is subject to damage at the gravity refueling port. This damage can cause external fuel leakage during subsequent closed circuit refueling operations. To preclude damage to the receptacle, the closed circuit nozzle will be used if possible when refueling. If however, the receptacle has been previously damaged and leakage occurs the following must be observed:

"HOT" closed circuit refueling operations (engine running) will not be conducted with a leaking receptacle, leaking fuel presents a serious fire hazard.

"COLD" closed circuit refueling operations with a leaking receptacle should be discontinued and the gravity refueling method used until the receptacle can be replaced or repaired.

d. Closed Circuit Refueling.

- (1) Remove fuel cap.
- (2) Ensure that gravity refueling port is closed. If not, rotate inner sleeve counterclockwise until gravity refueling port is closed and flange of sleeve is in contact with rivet at base of receiver cylinder.

CAUTION

Ensure that servicing vehicle pressure is not above 125 PSI while refueling.

- (3) Insert fueling nozzle into receiver and actuate automatic nozzle lever to ON or FLOW position. Pin at base of nozzle will momentarily indicate when fuel flow stops.

- (4) Fuel flow will automatically shut off when normal fuel level is reached. Just prior to normal shut off fuel flow may cycle several times as fuel level is reached. Gage on servicing vehicle will indicate when flow is stopped.

- (5) When fuel flow has stopped, actuate lever to OFF on nozzle, disconnect nozzle from receiver and replace filler cap.

- (6) Disconnect fuel nozzle ground and rewind hose assembly.

- (7) Disconnect servicing vehicle ground from helicopter.

- (8) Disconnect servicing vehicle ground from grounding stake.

CAUTION

If helicopter is equipped with closed circuit refueling system and fuel servicing vehicle is not equipped with related nozzle for closed circuit refueling, a gravity system may be used providing the servicing nozzle does not exceed 1.75 inches outside diameter. To refuel utilizing the gravity nozzle, it is necessary to position the inner sleeve of receiver until slot is lined up with fuel port in bottom of receiver. Position nozzle into port in order to by-pass closed circuit valve. Damage could result to the closed circuit refueling system if caution is not used to prevent damage to inner sleeve of receiver at fuel port through improper use of nozzle.

e. Gravity Refueling.

- (1) Remove fuel cap.
- (2) Rotate inner sleeve clockwise until sleeve clears port in bottom of fuel receiver.
- (3) Position nozzle into port of fuel receiver.
- (4) Fill to specified level.

(5) Remove nozzle and rotate inner sleeve counterclockwise until gravity refueling port is closed and flange of inner sleeve is in contact with rivet at base of receiver cylinder.

(6) Reinstall filler cap.

(7) Disconnect fuel nozzle ground and rewind hose.

(8) Disconnect servicing vehicle ground at helicopter.

(9) Disconnect servicing vehicle ground at grounding stake.

f. Defueling and Draining.

(1) Remove fuel cap; rotate inner sleeve clockwise until end of sleeve clears port in bottom of fuel receiver.

(2) Insert a suction pickup from a defueler vehicle into the fuel filler opening and remove all possible fuel.

(3) To complete defueling, drain remaining fuel into a suitable container by opening fuel cell sump drain.

2-70. Engine Oil System Servicing.

CAUTION

An engine high oil level coupled with a transmission low oil level condition indi-

cates a possible failure of the engine gearbox seal(s) which is allowing oil to be transmitted from the transmission through the freewheeling unit into the engine.

Engine oil tank (figure 2-16) is located aft of the engine and oil cooler fan. Oil level is checked by a "trapped ball" sight gage on the tank or removing the filler cap. Refer to table 2-1 for capacity and authorized oil.

2-71. Transmission and Gearbox Oil System Servicing.

a. Transmission. A sight glass (figure 2-16) located on the transmission housing is used to check the oil level in the transmission. The oil level must be visible in sight glass. If oil is visible, additional oil is not required. If oil is not visible in sight glass, add oil to the center dot only. Overfilling can cause aeration of oil and pressure fluctuation. Refer to table 2-1 for capacity and authorized oil.

b. Tail Rotor Gearbox. A sight glass (figure 2-16) is provided for ease in checking oil level. Fill to 1/8 inch above line with standard skid gear and to the line with high skid gear. Overfilling gearbox may cause excessive pressure to be generated and cause seals to leak. Refer to table 2-1 for capacity and authorized oil.

2-72. Hydraulic System Servicing.

The hydraulic system reservoir (figure 2-16) is located on the forward side of the transmission. A sight glass with ball float or line level is provided to determine low quantity of fluid in the reservoir. Refer to table 2-1 for capacity and authorized fluid.

2-73. Blade Grips and Pillow Blocks Servicing.

a. Oil Lubricated Hub. Blade grips and pillow blocks on the main rotor hub are lubricated with oil from reservoirs. Oil level can be checked through transparent covers and sight glasses. Inspect sight glass for oil contamination. When water is present, the oil has a dirty milky appearance. Fill blade grip and pillow block reservoirs to 1/2 full level on sight glass. Refer to table 2-1 for capacities and authorized fluids.

b. Grease Lubricated Hub. Blade grips and pillow blocks on the main rotor hub are lubricated with grease through lubrication fittings. The grips have a relief valve located on each pitch horn.

2-74. Ground Handling.

Towing. Two rings (figure 2-17) are provided on forward inboard portion of each landing gear skid for attachment of a standard helicopter tow bar. Helicopter is towed on ground handling wheel assemblies mounted on the landing skids.

2-75. Covers.

a. Engine Inlet and Pitot Tube. A combined engine inlet and pitot tube cover (figure 2-17) is provided to prevent entrance of dust etc., into the engine inlet and pitot system when helicopter is parked.

b. Engine Exhaust. Individual covers (figure 2-17) are provided for the exhaust stacks to prevent entrance of foreign objects into the engine exhaust when helicopter is parked.

c. Main Rotor Tiedown. A rotor tiedown (figure 2-17) is provided for use in mooring the aft main rotor blade. The tiedown prevents the rotor from seeing when the helicopter is parked. Ensure that strap side of tiedown boot is on top side of blade and drain hole is positioned at bottom of blade.

2-76. Mooring.

a. If a paved ramp with suitable tiedown rings is available, park helicopter headed in direction from which highest forecast winds are expected. Secure helicopter to ramp tiedowns at helicopter jacking tiedown fittings (figure 2-17). Use of a clevis at each of the tiedown fittings will permit use of larger diameter rope.

b. If suitable spaced ramp tiedown are not available, park the helicopter on an unpaved parking area headed in the direction from which the highest forecast winds are expected and retract ground handling wheels. Use mooring anchors to make "dead man" anchors. Moor helicopter as described in preceding step.

c. Secure main rotor with tiedown strap.

d. Install covers on pitot tube, engine exhaust, and engine inlets (figure 2-17). Alternate method for installation of pitot and engine inlet covers in high wind conditions is as follows: Route strap from pitot tube through the lower front edge of pilot door near lower hinge, and then out the top edge of door to engine air inlets. This will help to prevent marring and streaking of windshields.

e. Tighten friction on cyclic and collective controls.

f. Close all windows, doors, and access panels.

g. Fill fuel tank to capacity with prescribed fuel.

h. Secure all ground handling equipment.

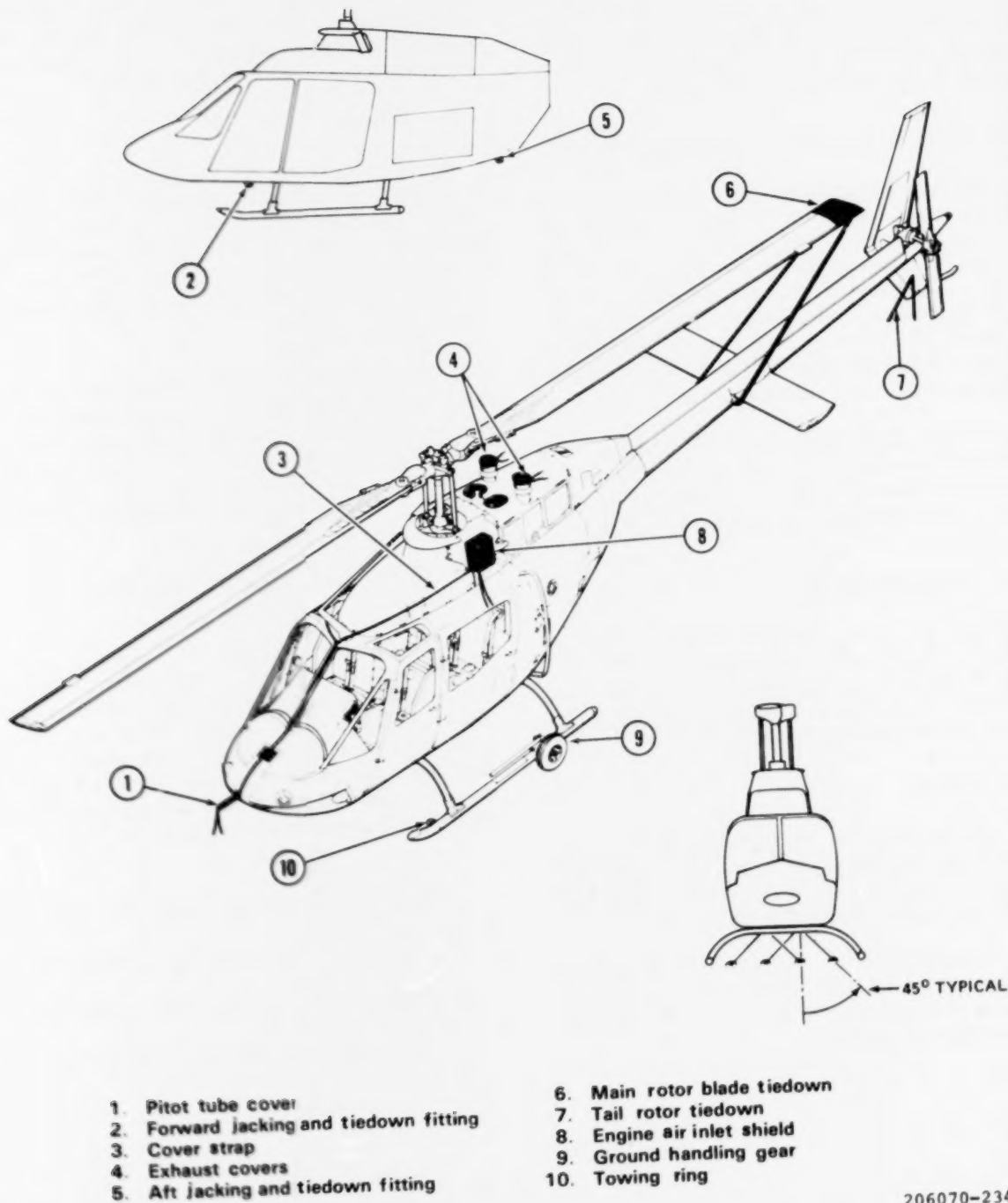


Figure 2-17. Ground handling equipment, covers, rotor tiedowns and mooring diagram

CHAPTER 3

AVIONICS

Section I. GENERAL

3-1. Introduction.

This chapter covers the avionics equipment configuration installed in the helicopter. It includes a brief description of the avionics equipment, its technical characteristics, capabilities, and location. This chapter also contains complete operating instructions for all avionics equipment installed in the helicopter. Refer to figure 3-1 for nomenclature and common names.

3-2. Avionics Equipment Configuration.

Refer to figures 3-1 and 3-2 for equipment installed in helicopter.

3-3. Power Supply.

A 28 Vdc power supply is utilized for avionics equipment. Refer to figure 2-14.

NOMENCLATURE	COMMON NAME	USE	RANGE
Communication System Control C-6533/ARC	Interphone Control	Interphone for pilot and crew; integrates all communication equipment.	Stations within helicopter.
Radio Set AN/ARC-114	VHF-FM Radio	Two way voice communications in frequency range of 30.00 to 75.95 MHz.	Line of sight
Communication Security Set TSEC/KY-28	Voice Security Equipment	In conjunction with the FM radio set provides secure two-way voice communications.	
Radio Set AN/ARC-115	VHF-AM Radio	Two way voice communications in frequency range of 116.00 to 149.975 MHz.	Line of sight
Radio Set AN/ARC-116 (or AN/ARC-164)	UHF-AM Radio	Two way voice communication in frequency range of 225.00 to 399.95 MHz.	Line of sight
Gyromagnetic Compass Set AN/ASN-43	Compass Set	Navigation aid.	
Direction Finder Set AN/ARN-89	ADF Set	Radio range navigation and position fixing, automatic direction finding, and homing in the frequency range 100 to 3000 KHz.	150 to 200 miles average depending on terrain interference noise.

Figure 3-1. Avionics equipment configuration (Sheet 1 of 2)

NOMENCLATURE	COMMON NAME	USE	RANGE
Radio Set AN/ARN-123 (V) 1	Conus Navigation Receiver	With appropriate instrumentation provides: VHF omnidirectional range (VOR), localizer (LOC), glideslope (GS), and marker beacon (MB) position information.	Line of sight
Radar Altimeter AN/APN-209	Radar Altimeter	Provides altitude indication above terrain. Permits selected altitude limits and visual warning when altitude is above or below selected limits.	0 to 1500 feet above terrain.
Radar Warning AN/APR-39	Radar Warning Set	Visual and audible warning when a high radar threat environment is encountered.	Line of sight
Transponder Set AN/APX-100	IFF Transponder Radio	Transmits a special coded reply for radar interrogator systems.	Line of sight
Proximity Warning System YG-1054	Proximity Warning Device	Provides proximity warning in high density aircraft areas to avoid mid-air collision.	Line of sight
Indicator, Heading-Radio Bearing ID-1351C/A	HBI	Provides magnetic heading, VOR or ADF bearing, and homing information.	
Indicator, Course Deviation ID-1347C/ARN	CDI	Provides VOR course deviation, localizer and glideslope signal information.	

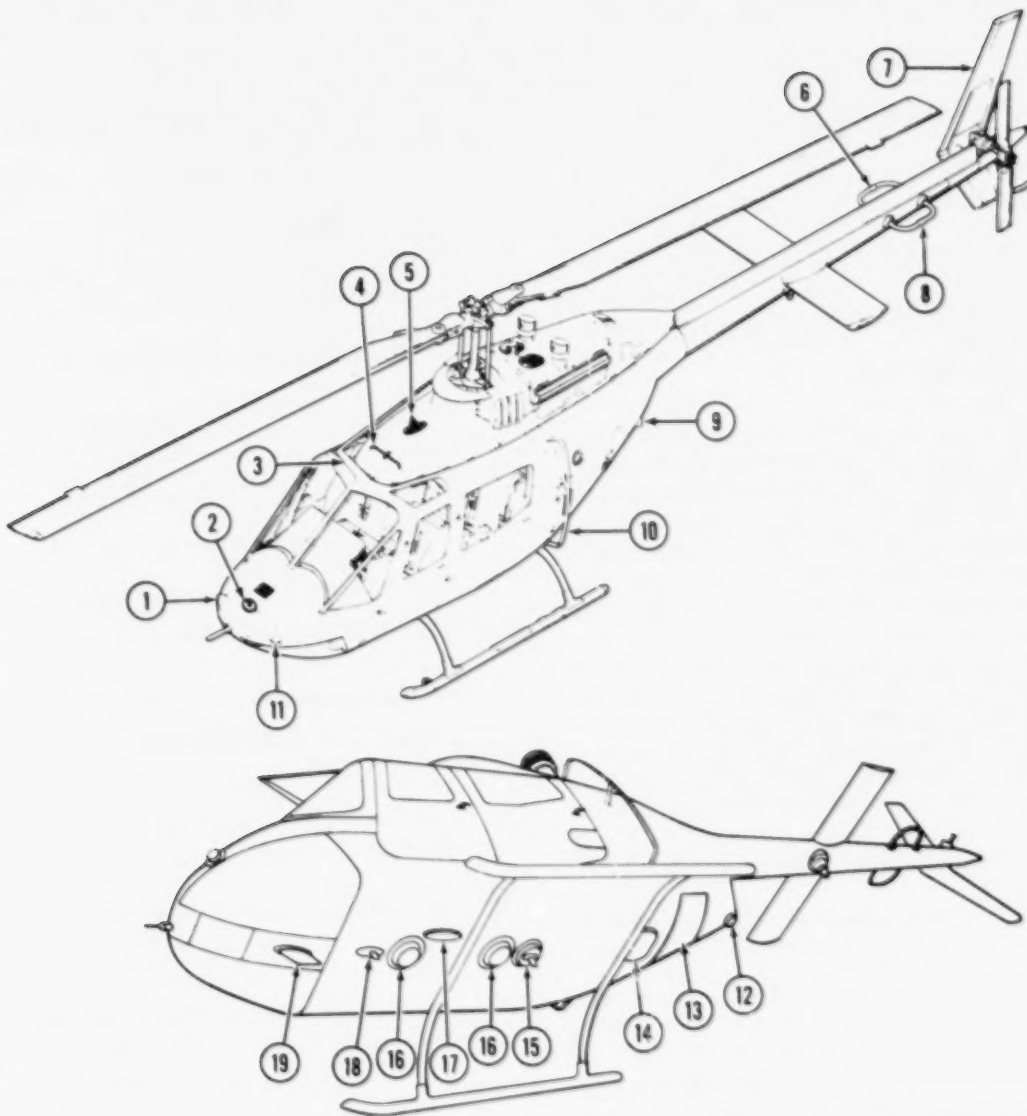
Figure 3-1. Avionics equipment configuration (Sheet 2 of 2)

Section II. COMMUNICATIONS.

3-4. Interphone Control.

a. Description. The communications system control, C-6583/ARC (figure 3-3) provides an intercommunications capability and control of radio communications. Two of the control panels are installed on the helicopter instrument panel, one each for the pilot and the copilot/observer. A third control panel is installed on the right side overhead in the passenger compartment. The control panels may be used in any one of three different modes as determined by the setting of switches and controls on the panel. The three modes of

operation are: two-way radio communication; radio receiver monitoring; and intercommunication within the helicopter. The interphone control has four direct audio inputs. The transponder set (AN/APX-100), radar warning (AN/APX-39), and marker beacon (AN/ARN-123 (V)) are connected to each C-6583/ARC, but cannot be disabled at the control. The marker beacon is controlled by the ICS VOL control and the IFF and radar warning are not controlled by the ICS VOL control. A fourth direct audio input is reserved for proximity warning and is controlled by the ICS VOL control.



- | | |
|---|--|
| 1. Antenna, radar warning - fwd right side | 11. Antenna, radar warning - fwd left side |
| 2. Antenna, proximity warning - fwd | 12. Antenna, proximity warning - aft |
| 3. Antenna, FM No. 2 | 13. Antenna, ADF sense |
| 4. Antenna, glideslope | 14. Antenna, ADF loop |
| 5. Antenna, top transponder | 15. Antenna, radar warning - blade |
| 6. Antenna, VOR - right side | 16. Antenna, radar altimeter |
| 7. Antenna, VHF/FM | 17. Antenna, marker beacon |
| 8. Antenna, VOR - left side | 18. Antenna, bottom transponder |
| 9. Antenna, radar warning - aft left side shown,
aft right side opposite | 19. Antenna, UHF |
| 10. Antenna, FM homing - left side shown,
right side opposite | |

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Figure 3-2. Antenna locations

b. *Controls and Functions.* Refer to figure 3-3.

c. *Operating Procedures.*

(1) Transmit interphone selector switch — As required.

(2) Receivers switches — As required.

(3) HOT MIKE switch — As required.

(4) VOLUME control — Adjust.

3-5. VHF-FM Radio Sets.

a. *Description.* The No. 1 and No. 2 FM radio sets AN/ARC-114 (figure 3-4) provide two-way frequency modulated (FM) narrow band voice communication. The No. 1 FM radio has homing capabilities in the frequency range of 30.00 to 75.95 MHz, and operates in secure voice mode with the TSEC/KY-28 equipment. The FM set operates on 920 channels for a distance of approximately 50 miles as limited by line of sight. Homing information is presented to the heading-radio bearing indicator (HBI) and displayed by the steering, station approach, and FM signal strength indicators. The FM radio set must be set to HOMING mode to initiate homing. The sets utilize position numbers 1 and 5 of the C-6533/ARC intercommunications control panel. Both FM radio sets are labeled VHF FM COMM and are mounted in the instrument panel.

b. *Controls and Functions.* Refer to figure 3-4.

NOTE

When transmitting and/or receiving on FM in secure mode, do not key or transmit simultaneously on any other transmitter.

c. *Operating Procedures.* Each FM radio transmitter and receiver units operate on the same frequency and are simultaneously tuned by frequency selector knobs on the front panel. When the function selector switch is in the T/R GUARD position, a fixed tuned guard receiver is energized to provide constant monitoring of the FM distress frequency regardless of the radio frequency setting. The signal volume level is adjusted by the AUDIO control on the panel, and is then applied to the ICS control panels for selection. When the appropriate switch selection is made, the audio is amplified in the ICS control panel.

(1) Transmit/Receive.

(a) Function selector — As desired.

(b) Frequency — Select.

(c) RCVR TEST — Press to test.

(d) AUDIO — Adjust.

(e) Transmit.

1 Transmit-Interphone selector — Number position (1 — No. 1 FM, 5 — No. 2 FM)

2 RADIO transmit switch — Press.

(2) Homing (No. 1 FM Radio Set).

(a) Function selector — HOMING.

(b) AUDIO — Adjust

(c) Observe homing indications on the heading-radio bearing indicator.

(3) Retransmission.

NOTE

Crew transmission may also be made while in RETRAN mode.

(a) Frequencies — Select (both FM sets).

NOTE

Frequencies must have a minimum of five MHZ difference, such as 30.00 MHZ and 35.00 MHZ.

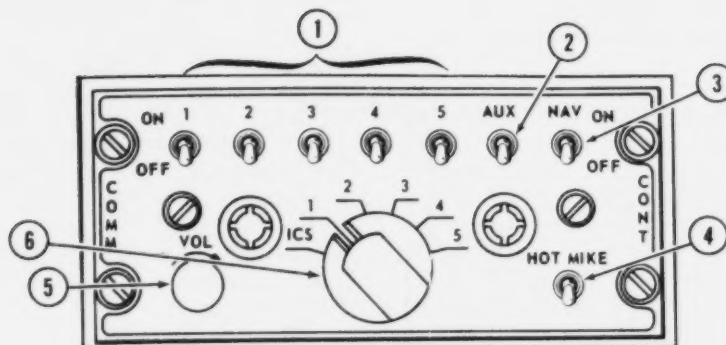
(b) Communications — Establish with each FM facility by selecting number 1 position and then number 5 position on the Transmit-Interphone selector.

(c) Function selectors — RETRAN (both FM sets).

(d) Receivers switches (C-6533/ARC control panel) — Number 1 and number 5 positions, as desired, for monitoring.

(4) Stopping Procedure.

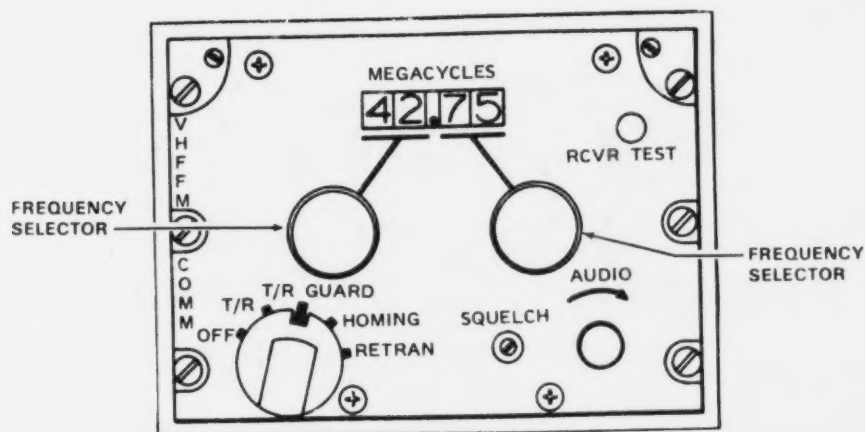
Function Selector — OFF.



CONTROL/INDICATOR	FUNCTION
1. Receiver Switches 1 — VHF/FM ARC-114 () ,No. 1 2 — UHF ARC-116 or ARC-164 3 — VHF/AM ARC-115 4 — Not Used 5 — VHF/FM ARC-114 () ,No. 2	Connect (ON) or disconnect OFF) communications receivers from the headsets.
2. AUX Receiver Switch	Connects (ON), or disconnects (OFF), VOR set receiver ARN-123(V)1 from the headset.
3. NAV Receiver Switch	Connects (ON), or disconnects (OFF), ADF navigation receiver ARN-89B from headset.
4. HOT MIKE Switch	Permits hand-free intercommunications with transmit-interphone selector in the ICS position.
5. VOL Control	Adjusts volume from receivers. Adjusts intercommunications volume.
6. Transmit-Interphone Selector 1 — VHF/FM ARC-114 () , No. 1 2 — UHF ARC-116 or ARC-164 3 — VHF/AM ARC-115 4 — Not Used 5 — VHF/FM ARC-114 () ,No. 2 ICS	Selects transmitter to be keyed and connects microphone to transmitter. Connects the microphone to the intercommunications system only, disconnecting microphone from transmitters.

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Figure 3-3. Interphone control panel



CONTROL/INDICATOR	FUNCTION
Function Selector	
OFF	Power off.
T/R	Receiver — ON; Transmitter — Standby
T/R GUARD	Guard receiver — ON; Transmitter — Standby; Receiver — ON
	NOTE
	Reception on the guard receiver is unaffected by frequencies selected for normal communications.
	NOTE
	The guard frequency can be selected on the main receiver.
HOMING	Activates the homing mode and displays on HBI indicator. May also be used for normal voice communications. The communications antenna is automatically selected when the transmitter is keyed.
RETRAN	Retransmission may be accomplished when the second FM radio set is installed.
Frequency Selectors — Indicator	
Left	Selects first two digits of desired frequency.
Right	Selects third and fourth digits of desired frequency.
RCVR TEST Switch	When pressed, audible tone indicates proper receiver performance.
SQUELCH Control	Squelch control adjusted by maintenance personnel only.
AUDIO control	Adjusts receiver volume.

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Figure 3-4. VHF/FM radio set

3-6. Voice Security Equipment.

a. *Description.* The voice security equipment TSEC/KY-28 and audio threshold device are used in conjunction with the No. 1 FM radio set to provide secure, two-way voice communications. The encoder portion of the secure-voice encoder/decoder translates the microphone audio to coded voice for application to the No. 1 FM radio transmitter. Secure audio signal from the No. 1 FM radio receiver is applied to the secure-voice encoder/decoder for translation to clear-voice audio.

NOTE

When transmitting and/or receiving on FM in secure mode, do not key or transmit simultaneously on any other transmitter.

(1) The TSEC/KY-28 encoder/decoder is installed in the avionics compartment. The system is controlled by the C-8157/ARC control-indicator installed in the lower console (figure 3-5).

(2) When the KY-28 system is operated in the CIPHER mode, the TSEC/KY-28 encoder/decoder and the audio threshold device become an integral part of the secure two-way communication. The audio threshold device serves to ensure adequate audio crosstalk isolation in the intercommunication system by muting the secure radio No. 1 FM sidetone and received audio at the ICS station keying a nonsecure communication radio. With the KY-28 system in the CIPHER mode and the pilot communicating on the secure FM radio, the pilots radio sidetone will be present at the other ICS stations. If either of the other stations keys a nonsecure radio, the secure radio sidetone will be muted from the ICS station keying the nonsecure radio.

b. *Controls and Functions.* Refer to figure 3-5.

c. *Operating Procedures.*

(1) Preliminary.

(a) Set the control indicator POWER switch to ON. The POWER switch must be in the ON position, regardless of the mode of operation, whenever the indicator is installed.

(b) Apply power to No. 1 FM radio set.

(c) When power is initially applied, an automatic alarm procedure is initiated.

1 A constant tone is heard in the headset and after approximately two seconds the constant tone will change to an interrupted tone.

2 To clear the interrupted tone, depress and release the RADIO TRANSMIT switch. The interrupted tone will no longer be heard, and the circuit will be in a standby condition ready for either transmission or reception. No traffic will be passed if the interrupted tone is still heard after depressing and releasing the RADIO TRANSMIT switch.

(d) PLAIN-CIPHER switch — As required.

(2) Plain mode.

(a) Set the control indicator POWER switch to ON.

(b) Set the PLAIN-CIPHER switch to **PLAIN (indicated by blue light)**.

(c) Set the RE-X REG switch to REG; except when operating with retransmission units, at which time switch should be placed in the RE-X position.

(d) Press the RADIO TRANSMIT switch and speak into the microphone to transmit. Release the RADIO TRANSMIT switch for reception.

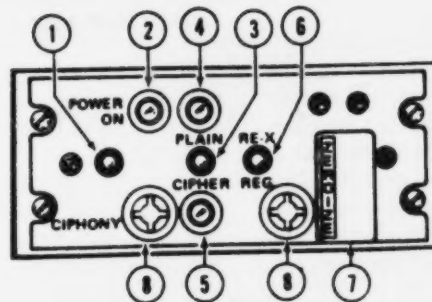
(3) Cipher mode.

(a) Set the PLAIN-CIPHER switch to **CIPHER (indicated by a blue light)**.

(b) Place the RE-X REG switch to REG, except when operating with retransmission units, at which time the switch will be placed in RE-X position.

(c) To transmit, press the RADIO TRANSMIT switch. DO NOT TALK; in approximately one-half second, a beep will be heard. This indicates the receiving station is now capable of receiving your message. Transmission can now commence. Only one voice security system can transmit on a given frequency. Always listen before attempting to transmit to assure that no one else is transmitting.

(d) When transmission is completed, release the RADIO TRANSMIT switch. This will return equipment to the standby condition.



CONTROL/INDICATOR	FUNCTION	CONTROL/INDICATOR	FUNCTION
1. POWER ON Switch Two Position Circuit Breaker	Connects power to the associated TSEC/KY-28 cipher equipment in the ON (forward) position, and disconnects power from the equipment in the OFF (aft) position.	6. RE-X-REG Switch (Two-Position Locking Toggle)	In the RE-X position, permits ciphered communications through a retransmission unit (at a distant location). In the REG position, permits normal ciphered communications or clear text.
NOTE Switch must be in the ON (forward) position for operation in the PLAIN or CIPHER mode.		7. ZEROIZE Switch (Two-Position Locking Toggle, Under Spring-Loaded Cover)	Normally in OFF (aft) position. Placed in ON (forward) position during emergency situations to neutralize and make inoperative the associated TSEC/KY-28 cipher equipment. Do not place the ZEROIZE switch in the ON (forward) position unless a crash or capture is imminent.
2. POWER ON (Blue) Indicator (With Dimmer Switch)	Lights when the associated POWER ON switch is placed in the ON (forward) position.	8. Panel Lights	Illuminate the control-indicator (controlled by aircraft panel lights).
3. PLAIN CIPHER Switch (Two-Position Locking Toggle)	In the PLAIN position, permits normal (unciphered) communications on the associated FM radio set. In the CIPHER position, permits ciphered communications on the associated radio set.		
4. PLAIN (Blue) Indicator (with Dimmer Switch)	Lights when the associated PLAIN-CIPHER switch is in the PLAIN position.		
5. CIPHER (Blue) Indicator (with Dimmer Switch)	Lights when the associated PLAIN-CIPHER switch is in the CIPHER position.		

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Figure 3-5. Voice security equipment control panel

(e) To receive, it is necessary for another station to send you a signal first. Upon receipt of a signal, the cipher equipment will be switched automatically to the receive condition, which will be indicated by a short beep heard in the headset. Reception will then be possible. Upon loss of the signal, the cipher equipment will be automatically returned to the standby condition.

3-7. VHF-AM Radio Set.

a. *Description.* The VHF-AM radio set AN/ARC-115 (figure 3-6) provides amplitude modulated (AM) narrow band voice communications within the frequency range of 116.00 to 149.75 MHz on 1360 channels. The set is effective to a distance of approximately 50 miles, line of sight. A guard receiver, fixed tuned to 121.50 MHz, is incorporated in the set. The set control is labeled VHF AM COMM and is mounted on the left side of the instrument panel. The set utilizes position 3 of the C-6533/ARC intercommunications control panel.

b. *Controls and Functions.* Refer to figure 3-6.

c. *Operating Procedures.*

(1) *Transmit/receive.*

(a) Function selector — As desired.

(b) Frequency — Select.

(c) RCVR TEST — Press to test.

(d) AUDIO — Adjust.

(e) Transmit.

1 Transmit-interphone selector — Number 3 position.

2 RADIO transmit switch — PRESS.

(2) *Stopping procedure.*

Function Selector — OFF.

3-8. UHF-AM Radio Set.

a. *Description.* The UHF-AM radio set AN/ARC-116 (or AN/ARC-164) (figure 3-7) provides two-way UHF amplitude modulated (AM) narrow band voice communications within the frequency range of 225.00 to 399.95 MHz on 3500 channels for a

distance of approximately 50 miles as limited by conditions. A guard receiver is incorporated in the set and is fixed tuned to 243.00 MHz. Both receivers are disabled during transmitter operation. The radio set is marked UHF AM COMM and is mounted in the bottom center section of the instrument panel. The UHF radio transmitter and main receiver operate on the same frequency and are simultaneously tuned by frequency selector knobs on the panel. The set utilizes position number 2 of the C-6533/ARC intercommunications control panel. The AN/ARC-164 provides for twenty preset channels in addition to the manual selection of channels. Preset selection is accomplished by positioning the mode switch to PRESET and function selector to MAIN. Select the desired frequency with the frequency selector knobs and press the PRESET push-button located under the access cover upper left portion of radio.

b. *Controls and Functions AN/ARC-116 and AN/ARC-164.* Refer to figure 3-7.

c. *Operating Procedures AN/ARC-116.*

(1) *Transmit/receive.*

(a) Function selector — As desired.

(b) Frequency — Select.

(c) RCVR TEST — Press to test.

(d) AUDIO — Adjust.

(e) Transmit.

1 Transmit — Interphone selector — Number 2 position.

2 RADIO transmit switch — PRESS.

(2) *Stopping procedure.*

Function Selector — OFF.

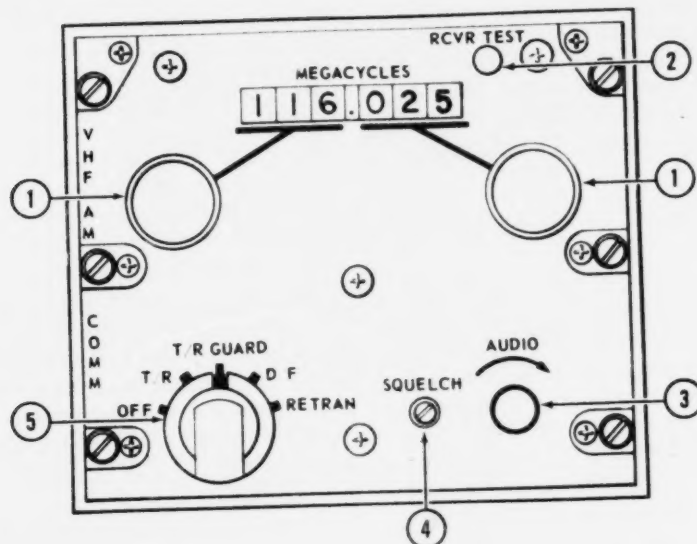
(3) *Emergency procedures.*

Function Selector — T/R GUARD.

d. *Operating Procedures AN/ARC 164.*

(1) *Transmit/receive.*

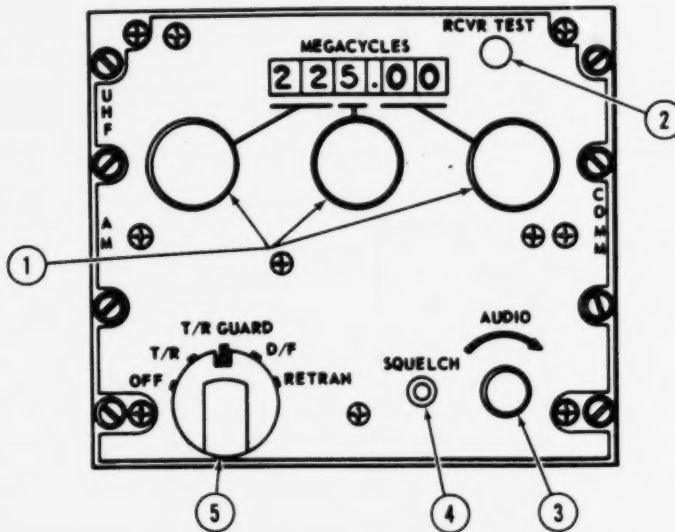
(a) Function selector — As desired.



CONTROL/INDICATOR	FUNCTION
1. Frequency Selectors	
Left	Selects first three digits of desired frequency.
Right	Selects fourth, fifth and sixth digits of desired frequency.
2. RCVR TEST Switch	When pressed, audible signal indicates proper receiver performance.
3. AUDIO Control	Adjusts receiver volume.
4. SQUELCH Control	Squelch control adjusted by maintenance personnel only.
5. Function Selector	
OFF	Power off.
T/R	Receiver — On Transmitter — Standby.
T/R GUARD	Receiver — On; Transmitter — Standby; Guard Receiver — On.
	NOTE
	Reception on guard frequency is unaffected by frequencies selected for normal communications.
D/F	Not used.
RETRAN	Not used.

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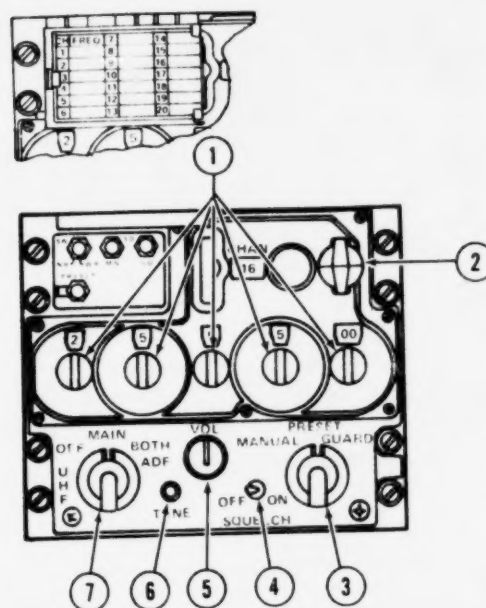
Figure 3-6. VHF radio set



CONTROL/INDICATOR	FUNCTION
1. Frequency Selectors	
Left	Selects first two digits of desired frequency.
Middle	Selects third digit (1 MHz) of desired frequency.
Right	Selects last two digits of desired frequency.
2. RCVR TEST Switch	When pressed, audible tone indicates proper receiver performance.
3. AUDIO Control	Adjusts receiver audio volume.
4. SQUELCH Control	Squelch control adjusted by maintenance personnel only.
5. Function Selector	
OFF	Power off.
T/R	Receiver — ON; Transmitter — Standby.
T/R GUARD	Receiver — ON; Transmitter — Standby; Guard Receiver — ON.
D/F	Not used.
RETRAN	Not used.

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Figure 3-7. UHF/AM radio set AN/ARC-116 (Sheet 1 of 3)



CONTROL/INDICATOR	FUNCTION
1. Frequency Selectors	
Hundreds	Selects first digit of desired frequency.
Tens	Selects second digit of desired frequency.
Units	Selects third digit (1 MHz) of desired frequency.
Tenths	Selects fourth digit of desired frequency.
Hundredths	Selects last two digits of desired frequency.
2. CHAN	Selects preset channels.
3. Mode Selector	
MANUAL	Frequency selected with frequency selector knobs.
PRESET	Selects preset channel as desired by CHAN selector.
GUARD	Frequency is automatically positioned to guard channel (243.00 MHz).
4. SQUELCH	
OFF	Received unsquelched.
ON	Received squelch operating.

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Figure 3-7. UHF/AM radio set AN/ARC-164 (Sheet 2 of 3)

CONTROL / INDICATOR	FUNCTION
5. VOL Control	Adjust receiver audio volume.
6. TONE	When pressed, audible tone indicates proper receiver/ transmitter performance (transmits on selected frequency).
7. Function Selector	
OFF	Power off.
MAIN	Receiver — ON. Transmitter — Standby.
BOTH	Receiver — ON. Transmitter — Standby. Guard Receiver — ON.
ADF	Not Used

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Figure 3-7. UHF/AM radio set AN/ARC-164 (Sheet 3 of 3)

(b) Frequency — Select

(c) TONE — Press to test.

(d) VOL — Adjust.

(e) Transmit.

$\frac{1}{2}$ Transmit — Interphone selector —
Number $\frac{1}{2}$ position.

2 RADIO transmit switch — PRESS.(2) *Stopping procedure.*

Function Selector — OFF.

(3) *Emergency procedures.*

Function Selector — BOTH.

Section III. NAVIGATION

3-9. Direction Finder Set.

a. Description. The direction finder set (ADF) AN/ARN-89 figure 3-8) is used in conjunction with gyromagnetic compass and intercommunications systems. ADF bearing information is indicated on the heading-radio bearing indicator (figure 3-9). The bearing pointer displays either the ADF bearing or the VOR bearing depending on the position selected on the **RMI BRG PNTR switch. The ADF set operates in the 100 to 3,000 KHz frequency range and is used to receive continuous wave (cw) or amplitude modulated (am) radio frequency signals. The three modes of operation for the ADF set include automatic homing in the COMPASS mode, manual homing in the LOOP mode, and as a communications receiver in the ANTenna mode. A beat frequency oscillator is included to provide an audible indication for identification and tuning and is activated by the CW switch. The radio set control unit is marked ADF RCVR and is mounted in the center section of the instrument panel.**

b. Controls and Functions. Refer to figure 3-8.

c. Operating Procedures.

(1) *Preliminary.*

(a) Interphone control panel receiving NAV switch — ON.

(b) RMI BRG PTR switch — ADF.

(2) *ADF operation.*

(a) Function selector — COMP.

(b) Frequency — Select.

(c) AUDIO — Adjust.

(d) TUNE meter — tune for maximum up needle deflection.

(3) *Manual operation.*

(a) Function selector — LOOP.

(b) VOICE CW switch — CW.

(c) Rotate LOOP control for maximum reception and retune.

(d) Rotate LOOP control to find audible null position and adjust volume for a 5 to 8 degree null width.

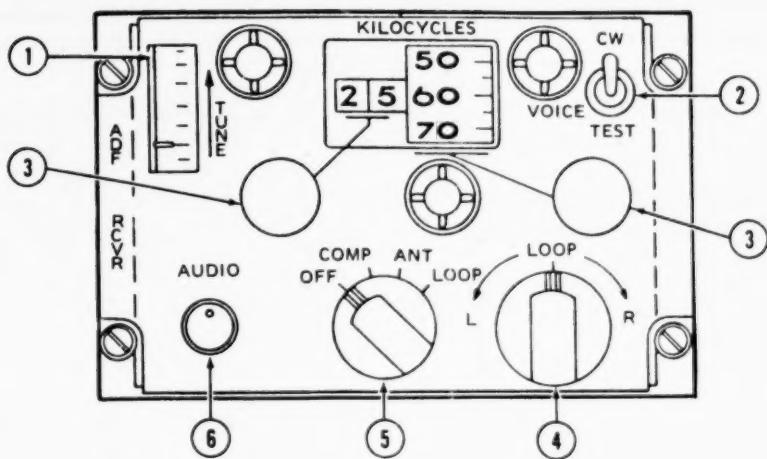
(e) Check for ambiguity — The ADF bearing pointer will either read the magnetic bearing to the station or be 180 degrees out.

(4) *Stopping procedure.*

Function selector — OFF.

3-10. Gyromagnetic Compass Set.

a. Description. The gyromagnetic compass set AN/ASN-43 is a directional sensing system which provides an accurate visual reference indication of magnetic heading (MAG) of the helicopter. The information provided by the system is used for navigation by displaying the magnetic heading of the helicopter and by presenting the magnetic heading as a reference signal to the VOR. The system may also be used as a free directional gyro (DG) in areas where magnetic reference is unreliable. The compass set supplies magnetic heading and compass synchronization information to the HBI (figure 3-9) located on the instrument panel. The compass system functions are deter-



CONTROL/INDICATOR	FUNCTION
1. TUNE indicator	Up deflection of the needle indicates most accurate tuning of the receiver.
2. CW VOICE TEST switch	
CW	Provides tone that may be used for identification, tuning, or CW station.
VOICE	Permits normal aural reception.
TEST	Rotates ADF bearing pointer 180 degrees from original bearing to provide a check of pointer accuracy with function selector in the COMP position, inoperative in LOOP and ANT positions. The switch is spring loaded away from TEST position.
3. Frequency selectors	
Left (coarse tune)	Selects first two digits of desired frequency.
Right (fine tune)	Selects third and fourth digits of desired frequency.
4. LOOP control	Manual positioning of loop antenna when ADF is operating in manual direction finding mode.
5. Function selector	
OFF	Power off.
COMP	ADF operation as an automatic direction finder. Activates bearing pointer on HBI.
ANT	Receiver provides aural information only.
LOOP	ADF operation as a manual direction finder using the loop antenna only.
6. AUDIO control	Adjusts receiver volume.

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Figure 3-8. Direction finder set control panel

mined by the DIR GYRO/MAG switch mounted in the right section of the instrument panel.

NOTE

Compass calibration card is maintained with the standby compass calibration card.

b. Controls and Functions. Refer to following step c, paragraph 3-11c and figure 3-9.

c. Operating Procedures.

(1) DIR GYRO/MAG switch — as desired; DG operation is recommended when flying in latitudes greater than 70 degrees.

(2) In MAG mode, the gyromagnetic compass system will remain synchronized during normal flight maneuvers. In normal operation, the annunciator (figure 3-9) will oscillate slightly about center position. During certain maneuvers the compass system may become unsynchronized, as evidenced by the annunciator moving off center. The slaving circuits in the compass system will slave slowly to remove errors and synchronize the system. If fast slaving is desired, turn the synchronizing knob in the direction indicated by the annunciator until the annunciator is centered.

(3) In the DG mode, the annunciator is inoperative and the gyro is unslaved. Approximately each 15 minutes, update the heading to the standby compass by rotating the synchronizing knob.

3-11. Heading — Radio Bearing Indicator (HBI)

a. Description. The HBI ID-1351 C/A (figure 3-9) is mounted on the instrument panel and provides magnetic heading information and radio bearings by displaying information from the gyromagnetic compass set, ADF, VOR, and FM radios. Additionally, it provides visual indications of gyromagnetic compass failure, compass synchronization and approach to an FM radio station. The compass correction card will be located in the front of the aircraft log book.

b. Controls and Functions. Refer to figure 3-9.

c. Operating Procedures.

(1) *Gyromagnetic Heading Display and Synchronization.*

(a) Gyromagnetic heading dial rotates to indicate the helicopters magnetic heading under the index.

(b) Heading synchronization is accomplished by rotating the synchronizing knob. The annunciator indicates, by means of a dot (●) or cross (+), the direction that the synchronizing knob should be turned to give immediate and accurate synchronization. If a cross (+) is showing in the annunciator, the synchronizing knob should be turned counterclockwise. The system is synchronized when the annunciator indicates neither a dot (●) nor a cross (+). If, shortly after synchronizing the system, the heading dial drifts and a dot (●) or cross (+) appears in the annunciator, then the system was synchronized to a false null 180 degrees out and must be resynchronized to the correct helicopter heading. The standby magnetic compass may be checked for reference.

(2) *Bearing pointer.* Radio magnetic bearing information is indicated by the bearing pointer of the indicator. The arrow end of this pointer indicates the bearing of the radio station from the helicopter (VOR or ADF as selected by the RMI BRG PTR switch located on instrument panel).

(3) *FM homing.*

(a) The steering indicator receives its input from the No. 1 FM radio homing system. By moving to the right or left of its center indication, the indicator displays helicopter deviation from a direct approach path to the FM radio transmitter. The indicator moves to the right when the homing transmitter site is to the right of the helicopter, and to the left when the transmitter is to the left of the helicopter.

(b) An FM signal strength indicator shows red whenever the FM radio receiver signal is absent or is too weak for a reliable indication. When the signal strength is acceptable, the FM warning indicator shows black.

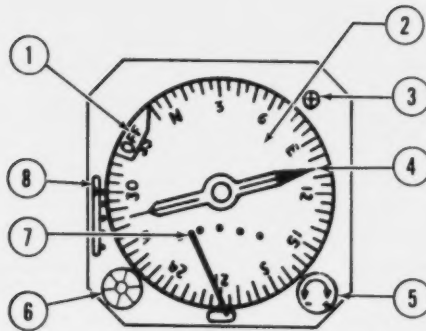
(c) The station approach indicator indicates helicopter approach to the FM radio transmitter. The pointer moves downward with increasing signal strength.

(4) Power warning indicator is displayed when electrical power is removed from the set if the AN/ASN-43 dc power supply becomes inoperative.

3-12. CONUS Navigation Receiver.**NOTE**

Keying of the AN/ARC-115, VHF-AM transmitter may cause the AN/ARN-123 VOR receiver to lose station lock-on. The RMI BRG PTR on the heading radio bearing indicator and the course pointer on the course deviation indicator will return to center position and the VOR NAV warning flag will appear. The VOR receiver will return to normal operation when the AN/ARC-115 transmitter is unkeyed.

a. Description. The CONUS navigation receiver AN/ARN-123 (V) receives the combined VOR (VHF



CONTROL/INDICATOR	FUNCTION
1. POWER WARNING INDICATOR	Indicates when ac power is not being supplied to the gyromagnetic compass or when the AN/ASN-43 ac power supply is inoperative.
2. HEADING DIAL	Indicates the helicopter magnetic heading under the index.
3. ANNUNCIATOR	Indicates by means of a dot (.) or cross (+) the direction the synchronizing knob (item 5) should be turned to give immediate and accurate synchronization.
4. BEARING POINTER	Indicates bearing of radio station from helicopter (VOR or ADF as selected by RMI BRG PNTR switch).
5. SYNCHRONIZING KNOB	Determines the heading synchronization.
6. SIGNAL STRENGTH INDICATOR	Indicates the presence or absence of an FM radio signal.
7. STEERING INDICATOR	Indicates helicopter deviation from a direct approach to the FM radio transmitter.
8. STATION APPROACH INDICATOR	Indicates helicopter approach to an FM radio transmitter.

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Figure 3-9. Heading-radio bearing indicator

omni-range) and LOC (localizer) signals over a frequency range of 108.00 to 117.95 MHz, GS (glide slope) signals over a frequency range of 329.15 to 335.00 MHz, and MB (marker beacon) signals on 75.00 MHz from ground transmitters. The receiver is controlled by the C-10048/ARN-123 control panel (figure 3-10) mounted on the lower right side of the instrument panel. The signals are visually displayed on the CDI (figure 3-11), the (figure 3-9), and the marker beacon light as required. The VOR and localizer audio signals are received from ground transmitters through the helicopter intercommunications system by placing the interphone control (figure 3-3) AUX switch to ON. The set enables the operator to determine his present position, direction to a given point, and fly a predetermined flight-path to a desired destination relative to a VOR facility. The localizer circuitry provides a visual display of the helicopter position relative to a localizer course. The marker beacon circuitry provides a visual display and aural tone to indicate helicopter position relative to a marker ground transmitter.

b. *Controls and Functions.* Refer to figure 3-10.

c. *Operating Procedures.*

(1) *System operation.*

(a) NAV VOL switch control — On and adjust.

(b) MB VOL switch control — On and adjust.

(c) VOR/MB/TEST switch — Press and release.

(d) Frequency selectors — As required.

(e) MB SENS switch — As required.

(f) RMI BRG PTR switch — VOR.

(g) Interphone control panel AUX switch — ON.

(h) Interphone control panel VOL control — Adjust.

(2) *Stopping procedure*

NAV VOL and MB VOL switch controls — OFF.

3-13. Course Deviation Indicator (CDI).

a. *Description.* The CDI ID-1347C/ARN (figure 3-11) is mounted on the right side of the instrument

panel and displays VOR, LOC, and GS bearing information received from the CONUS navigation receiver. Additionally, it provides visual indications of unreliably weak VOR, LOC, and GS signals or equipment malfunction (NAV and GS flags), to/from station indication, and course selection.

b. *Controls and Functions.* Refer to figure 3-11.

c. *Operating Procedures.* Refer to figure 3-11.

3-14. Proximity Warning Device.

a. *Description.* The proximity warning device warns the pilot by visual and aural means whenever one or more similarly equipped aircraft are within a selectable range and within an altitude of ± 300 feet of the protected helicopter. The proximity warning device has selectable ranges of 1000, 3000, and 5000 feet. The system differentiates between aircraft which are above his helicopter, at the same altitude, and those that are below. It, accordingly, issues a visual warning to the pilot and informs him that an intruder is above, below, or at the same altitude as his "protected" helicopter. The system operates on a cooperative basis with other aircraft having like equipment. Warning outputs are three blinking lights and an audio tone. Volume control is provided. The receiver-transponder (figure 3-12), located on the left side of the instrument panel, contains the controls and indicators associated with the system.

NOTE

Another configuration of the proximity warning device has a range selectability of 1000, 2000, and 3000 feet and is totally interchangeable within the system.

b. *Controls and Functions.* Refer to figure 3-12.

c. *Operating Procedures.*

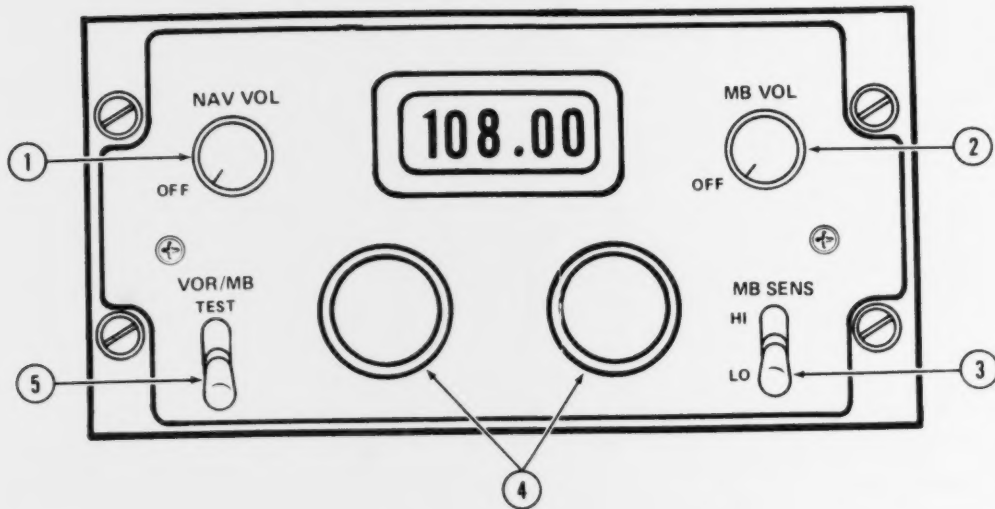
(1) *System operation.*

(a) POWER switch — On.

(b) RANGE SELECT switch — As desired.

(2) *System test.* TRANSPONDER GND TEST/CONFIDENCE TEST switch — Set and hold in desired test position.

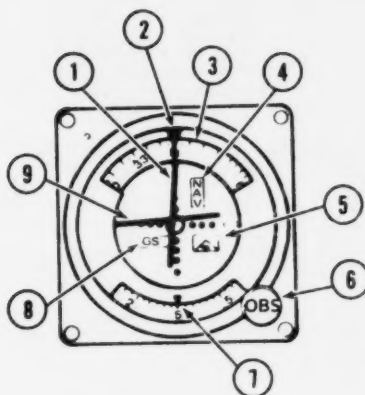
(3) *Stopping procedure.* POWER switch — OFF.



CONTROL/INDICATOR	FUNCTION
1. NAV VOL power switch and volume control NAV VOL OFF	Turns set on and controls VOR/LOC receiver volume. Turns set OFF.
2. MB VOL power switch and volume control MB VOL OFF	Turns set on and controls marker beacon volume. Turns set OFF.
3. MB SENS switch HI LO	Selects high receiver sensitivity. Selects low receiver sensitivity.
4. Frequency selectors Right Left	Selects the fractional megahertz portion of the desired frequency. Selects the whole megahertz portion of the desired frequency.
5. VOR/MB-TEST switch	Provides on and off capability for the VOR/MB self-test circuit within the receiver.

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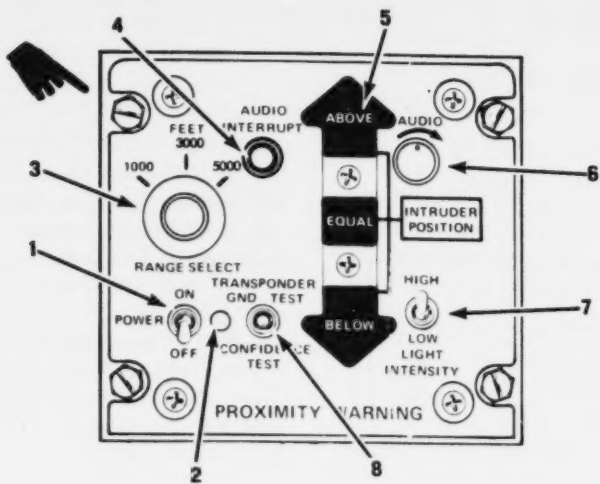
Figure 3-10. CONUS navigation receiver control panel



CONTROL/INDICATOR	FUNCTION
1. Course Pointer	Indicates deviation from selected VOR radial or LOC path.
2. Course Index	Provides reference point for course deviation card.
3. Course Deviation Card	Manually rotated card, driven by OBS control to indicate desired VOR radial directly beneath course index.
4. NAV Warning Flag	Red NAV flag indicates VOR or LOC signal is unreliably weak or malfunction in receiver.
5. To/From Flag	Indicates whether flying selected radial would direct helicopter toward (TO) or from (FR) VOR station.
6. Omnibearing Selector (OBS)	Drives course deviation card for course selection.
7. Reciprocal Course Index	Indicates radial 180 degrees from selected radial.
8. Glide Slope Warning Flag	Red GS flag indicates GS signal is unreliably weak or malfunction in receiver.
9. Glide Slope Pointer	Indicates deviation from glidepath.

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Figure 3-11. Course deviation indicator (CDI)



CONTROL/INDICATOR	FUNCTION												
1. POWER ON/OFF Switch	Controls 28 Vdc power to system.												
2. POWER Lamp	Indicates when 28 Vdc power is applied to system.												
3. RANGE SELECT Switch	Sets range gate circuitry to accept a reply signal within selected distances.												
4. AUDIO INTERRUPT Pushbutton Switch	Silences audio alarm signal for approximately one minute.												
5. INTRUDER POSITION Indicator Lamps	Flash singly or in combination to indicate position of intruder as follows: <table><tr><th>FLASHING LAMP(S)</th><th>RELATIVE INTRUDER POSITION</th></tr><tr><td>ABOVE</td><td>Between 110 and 300 feet above.</td></tr><tr><td>ABOVE and</td><td>Between 80 and 110 feet above.</td></tr><tr><td>EQUAL</td><td>Between 80 feet above and 80 feet below.</td></tr><tr><td>EQUAL and</td><td>Between 80 and 110 feet below.</td></tr><tr><td>BELOW</td><td>Between 110 and 300 feet below.</td></tr></table>	FLASHING LAMP(S)	RELATIVE INTRUDER POSITION	ABOVE	Between 110 and 300 feet above.	ABOVE and	Between 80 and 110 feet above.	EQUAL	Between 80 feet above and 80 feet below.	EQUAL and	Between 80 and 110 feet below.	BELOW	Between 110 and 300 feet below.
FLASHING LAMP(S)	RELATIVE INTRUDER POSITION												
ABOVE	Between 110 and 300 feet above.												
ABOVE and	Between 80 and 110 feet above.												
EQUAL	Between 80 feet above and 80 feet below.												
EQUAL and	Between 80 and 110 feet below.												
BELOW	Between 110 and 300 feet below.												
6. AUDIO Control	Varies the volume of the audio tone.												
7. LIGHT INTENSITY Switch	Switches INTRUDER POSITION and POWER indicator lamps to LOW or HIGH intensity.												
8. TRANSPONDER GND TEST/CONFIDENCE TEST Switch	In TRANSPONDER GND TEST position, permits unit to accept signals from ground transponder. In CONFIDENCE TEST position, switch initiates confidence test.												

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Figure 3-12. Proximity warning device

Section IV. TRANSPONDER AND RADAR

3-15. Transponder Set.

a. *Description.* The transponder set AN/APX-100 enables the helicopter to identify itself automatically when properly challenged by friendly surface and airborne radar equipment. The control panel (figure 3-13), located on the instrument panel, enables the set to operate in modes 1, 2, 3A, 4, C, and test. When computer KIT-1A/TSEC (classified) is installed, mode 4 is operational. The range of the receiver-transmitter is limited to line-of-sight transmission since its frequency of operation is in the UHF band making range dependent on altitude.

b. *Controls and Functions.* Refer to figure 3-13.

c. *Operating Procedures.*

(1) *Transponder operation.*

(a) MASTER control — STBY. Allow approximately 2 minutes for warmup.

(b) MODE and CODE — Select as required.

(c) TEST — As required.

(d) MASTER control — NORM or EMER as required.

(e) ANT — As desired.

(f) IDENT — As required.

(2) *Emergency operation.* MASTER control — EMER.

(3) *Stopping procedure.* MASTER control — OFF.

3-16. Radar Altimeter.

NOTE

Simultaneous operation of the AN/APR-39, radar warning receiver and the AN/APN-209 radar altimeter will cause a strobe to appear on the AN/APR-39 CRT and an audio tone can be heard in the headset for IGE hover.

a. *Description.* The radar altimeter AN/APN-209 (figure 3-14) is a short pulse, terrain tracking and altitude sensing radar system that measures and visually indicates by pointer and digital display actual clearance in feet between the helicopter and terrain over a range from zero to 1500 feet. The indicator contains all the electronic components necessary for the generation, reception, and tracking of the radar pulses. The indicator provides precise altitude indications with a manually set low-level and high-level warning flag to warn when a predetermined low or high altitude limit has been reached.

b. *Controls and Functions.* Refer to figure 3-14.

c. *Operating Procedures.*

(1) *Altimeter operation.*

(a) LO SET control knob — Clockwise from OFF. Set low limit index as desired.

(b) HI SET control knob — As desired to set high limit index as desired.

(2) *Self-test operation.*

(a) Set high limit index to 800 feet and low limit index to 50 feet.

(b) Push and hold HI SET control knob. Verify pointer indicates 1000 (± 175) feet, digital display reads 1000 (± 100) feet, and HI level warning flag is exposed.

(c) Release HI SET control knob. Verify pointer indicates 0 (± 5) feet, digital display reads 0 to 1 feet, and LO warning flag is exposed.

(3) *Stopping procedure.* LO SET control knob — Counterclockwise from LO.

3-17. Radar Warning Set.

NOTE

For simultaneous operation of the AN/APR-39, radar warning receiver and the Proximity Warning Device (PWD), the PWD will cause a strobe to appear on the AN/APR-39 CRT and an audio tone can

be heard in the headset. For simultaneous operation of the two systems, place the AN/APR-39 DSCRM switch to the ON position. For proper operation of the AN/APR-39 with the DSCRM switch OFF, the PWD must be OFF.

a. Description. The radar warning set ANPR-39 provides the pilot with visual and audible warning when a hostile fire-control threat encountered. The equipment responds to hostile fire-control radars but nonthreat radars are generally excluded. The equipment also receives missile guidance radar signals and, when the signals are time-coincident with a radar tracking signal, the equipment identifies the combination as an activated hostile surface-to-air (SAM) radar system. The visual and aural displays warn the pilot of potential threat so that evasive maneuvers can be initiated.

b. Controls and Functions. Refer to figure 3-15.

c. Operating Procedures.

(1) System operation.

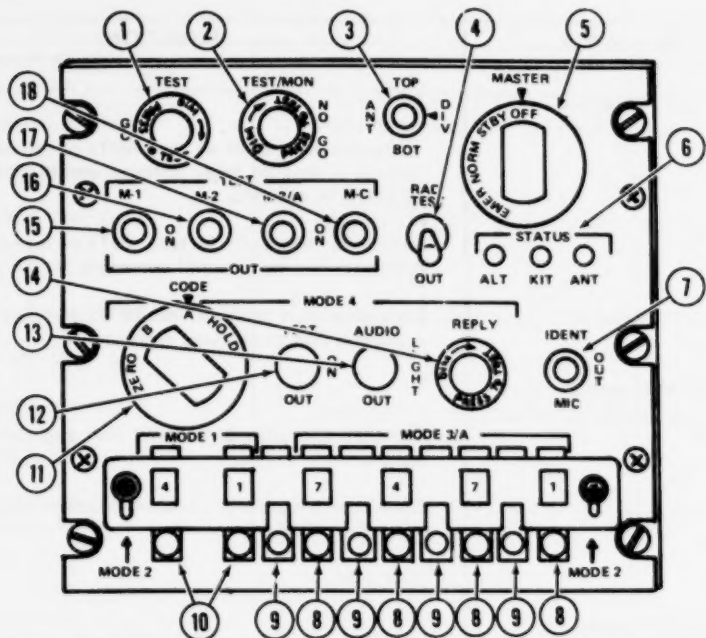
- (a)* PWR switch-ON.
- (b)* AUDIO control-Adjust.
- (c)* BRIL control-Adjust.
- (d)* NIGHT-DAY control-Adjust.

(2) Self-test operation.

(a) Press SELF TEST switch. Verify that within approximately three seconds the indicator displays a forward (0 degrees) or aft (180 degrees) strobe and an audio tone is heard.

(b) Approximately three seconds later, the opposite strobe should appear and the audio tone becomes stronger.

(3) Stopping procedure. PWR Switch - OFF.



CONTROL/INDICATOR	FUNCTION
1. TEST GO	Indicates successful built in test (BIT).
2. TEST/MON NO GO	Indicates unit malfunction.
3. ANT	
TOP	Selects antenna located on top of helicopter.
BOT	Selects antenna located on bottom of helicopter.
DIV	Selects both top and bottom antenna.
4. RAD TEST switch	
RAD TEST	Enables set to reply to TEST mode interrogations.
OUT	Disables to RAD TEST features.
5. MASTER control	
OFF	Turns set off.
STBY	Places in warmup (standby) condition.
NORM	Set operates at normal receiver sensitivity.
EMER	Transmits emergency replay signal to MODE 1, 2, or 3/A interrogations regardless of mode control settings.

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Figure 3-13. Transponder set control panel (Sheet 1 of 3)

CONTROL/INDICATOR	FUNCTION
6. STATUS indicators ANT KIT ALT	Indicates that built in test (BIT) or monitor (MON) failure is due to high voltage standing wave ratio (VSWR) in antenna. Indicates that built in test (BIT) or monitor (MON) failure is due to external computer. Indicates that built in test (BIT) or monitor (MON) failure is due to altitude digitizer.
7. IDENT-MIC switch IDENT OUT MIC	Initiates identification reply for approximately 25 seconds. Prevents triggering of identification reply. Spring loaded to OUT. Not used.
8. MODE 3/A code select switches	Selects and indicates the MODE 3/A four-digit reply code number.
9. MODE 2 code select switches	Selects and indicates the MODE 2 four-digit reply code number.
10. MODE 1 code select switches	Selects and indicates the MODE 1 two-digit reply code number.
11. MODE 4/CODE control HOLD/A/B/ZERO	Selects condition of code changer in remote computer. Functions of this switch are operationally classified.
12. MODE 4/TEST switch TEST ON OUT	Selects MODE 4 BIT operation. Selects MODE 4 ON operation. Disables MODE 4 operation.
13. MODE 4 AUDIO/LIGHT control AUDIO LIGHT OUT	MODE 4 is monitored by audio. MODE 4 is monitored by a light. MODE 4 not monitored.

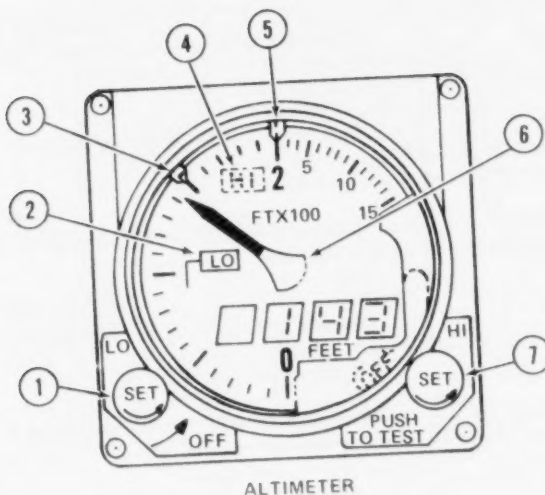
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Figure 3-13. Transponder set control panel (Sheet 2 of 3)

CONTROL/INDICATOR	FUNCTION
14. MODE 4/REPLY	Indicates that a MODE 4 reply is generated.
15. TEST/M-1 TEST/ON/OUT	Selects ON, OFF or BIT of MODE 1 operation.
16. TEST/M-2 TEST/ON/OUT	Selects ON, OFF, or BIT of MODE 2 operation.
17. TEST/M-3/A TEST/ON/OUT	Selects ON, OFF, or BIT of MODE 3/A operation.
18. TEST/M-C TEST/ON/OUT	Selects ON, OFF, or BIT of MODE C operation.

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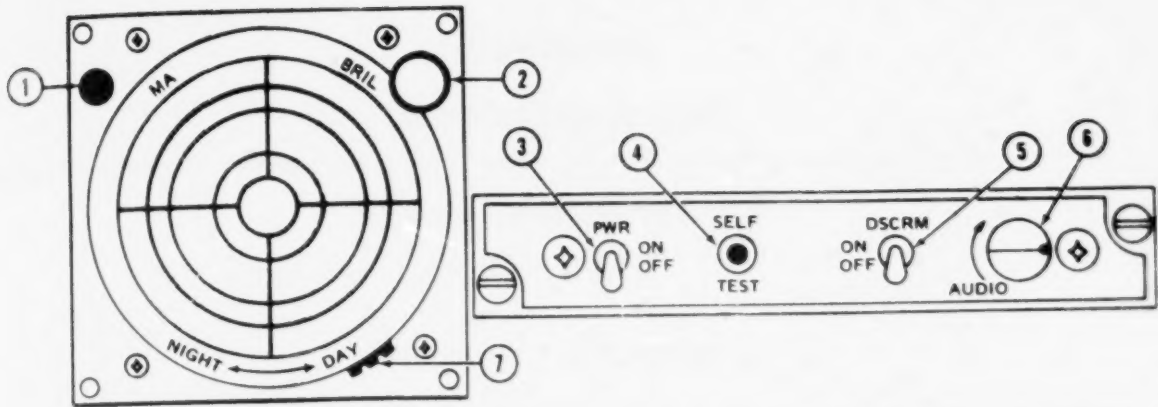
Figure 3-13. Transponder set control panel (Sheet 3 of 3)



CONTROL/INDICATOR	FUNCTION
1. LO SET control knob	Turns facility on and off, and sets low altitude limit index.
2. LO level warning flag	Indicates LO when altitude reaches respective limit index.
3. Low limit index	Manually sets low altitude limit index. Actuates LO level warning flag when limit reached.
4. HI level warning flag	Indicates HI when altitude reaches respective limit index.
5. High limit index	Manually sets high altitude limit index. Actuates HI level warning flag when limit reached.
6. Altitude pointer	Indicates actual clearance in feet from helicopter to terrain (zero to 1500 feet).
7. HI SET control knob	Sets high altitude limit index and operates self-test mode.

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Figure 3-14. Radar altimeter



CONTROL/INDICATOR	FUNCTION
1. MA Indicator	Flashing indicates high radar missile threat with DSCRM switch in ON.
1A. Flip filter	Filters light for NVG operation.
2. BRIL Control	Adjusts indicator illumination.
3. PWR Switch: ON OFF	Turns set on. Turns set off.
4. SELF-TEST Switch: With DSCRM Switch OFF With DSCRM Switch ON	No indications. One strobe appears at a cardinal point and primary (normal) audio tone is heard. After short delay, a second strobe will appear 180 degrees from the initial strobe. After another short delay, MA light will start flashing and audio warning (whaling) tone is heard.
5. DSCRM Switch: OFF ON	Without missile activity — Provides strobe lines for ground radar and normal audio indications. With missile activity — Provides strobe lines for ground radar, flashing strobe line(s) for missile activity, and flashing MA (missile alert) light. Without missile activity — No indications. With missile activity — Flashing strobe lines for missile activity (no strobe lines for ground radar), flashing MA light, and audio warning (whaling) tone.
6. AUDIO Control	Adjusts radar warning audio volume.
7. NIGHT-DAY Control	Polarized / blue filter for night / day.

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Figure 3-15. Radar warning indicator and control

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CHAPTER 4

MISSION EQUIPMENT

Section I. MISSION AVIONICS

(Not Applicable)

Section II. ARMAMENT

(Not Applicable)

CHAPTER 5

OPERATING LIMITS AND RESTRICTIONS

Section I. GENERAL

5-1. General.

a. This chapter includes all important operating limits and restrictions that shall be observed during ground and flight operations.

b. The operating limitations set forth in this chapter are the direct results of design analysis, tests, and operating experiences. Compliance with these limits will allow the pilot to safely perform the assigned missions and to derive maximum utility from the helicopter. Limits concerning maneuvers, weight, and center of gravity limitations are also covered in this chapter.

5-2. Exceeding Operational Limits.

Anytime an operational limit is exceeded an appropriate entry shall be made on DA Form 2408-13. Entry shall state what limit or limits were exceeded, range, time beyond limits, and any additional data that would aid maintenance personnel in the inspection that is required.

5-3. Minimum Crew Requirements.

The minimum crew requirement consists of only the pilot, whose station is at the right side of the aircraft. Additional crewmembers as required will be added at the discretion of the commander, in accordance with pertinent Department of the Army regulations.

Section II. SYSTEM LIMITS

5-4. Instrument Markings. (Figure 5-1)

a. *Instrument Marking Color Codes.* Operating limitations and ranges are illustrated by the colored markings which appear on the dial faces of engine, flight and utility system instruments. RED markings on the dial faces of these instruments indicate the limit above or below which continued operation is likely to cause damage or shorten life. The GREEN markings on instruments indicate the safe or normal range of operation. The YELLOW markings on instruments indicate the range when special attention should be given to the operation covered by the instrument. Operation is permissible in the yellow range, but is time limited. Green areas will have a single line and yellow areas two yellow lines. This is for identification under night lighting conditions or when using night vision goggles.

b. The instrument markings containing the saw tooth red line (↗) is placed on the dial face with respect to the operating limit as shown in figure 5-1. The saw tooth edge of the red lines cautions the pilot that he is approaching a limit as shown in figure 5-1. A white

dot on the face of the instrument indicates the safe or normal range of operation. A chevron (<) indicates above or below operating limits and to go in direction of point.

5-5. Rotor Limitations.

Refer to figure 5-1 for rotor limitations.

5-6. Transmission Oil Pressure Limits.

Refer to figure 5-1 for transmission oil pressure limitations.

5-7. Wind Limitations.

a. The helicopter can be started in a maximum wind velocity of 45 knots and a maximum gust spread of 15 knots.

NOTE

Gust spreads are not normally reported. To obtain spread, compare minimum and maximum wind velocities.



AIRSPEED

- 0 to 120 Knots Continuous Operation
- 120 Knots Maximum. Refer to figure 5-2 for additional information (AIRSPEED LIMITS)
- 100 Knots Recommended Maximum for Autorotation



TRANSMISSION OIL PRESSURE

- 30 to 60 PSI Continuous Operation
- 30 PSI Minimum
- 70 PSI Maximum



AMMETER



ROTOR TACHOMETER

- 93 to 110 Percent Continuous Operation
- 49 to 58 Percent Continuous Operation Prohibited
- 93 Percent Minimum
- 110 Percent Maximum

ENGINE TACHOMETER

- 98 to 100 Percent Continuous Operation
- 100 Percent Maximum
- 15 Second Maximum Transient N2 Limit is 110% (Autorotation)

Figure 5-1. Instrument markings (Sheet 1 of 3)



TORQUEMETER

0 to 85 Percent Continuous Operation

85 to 100 Percent 5 Minute Operation

100 Percent Maximum



ENGINE OIL PRESSURE

50 PSI MINIMUM

CAUTION

DISREGARD yellow and green instrument markings for engine oil pressure.

50—130 PSI Idle to 78% N1

90—130 PSI 78% to 89% N1

115—130 PSI 90% N1 and above

130 PSI MAXIMUM

NOTE

During cold weather start, maximum may go to 150 PSI, but you must remain at engine idle position until normal limits are attained.



TURBINE OUTLET TEMPERATURE INDICATOR

STARTING

0°C to 810°C Normal

810°C to 927°C Maximum 10 Seconds

927°C Maximum 1 Second

CONTINUOUS OPERATION

300°C Minimum

300°C to 738°C Continuous Operation

738°C to 810°C 30 Minute Limit

810°C Maximum. 810°C to 843°C during power transient 6 seconds maximum.

ENGINE OIL TEMPERATURE

60°C to 107°C Continuous Operation

107°C Maximum

NOTE

During cold weather operation the engine may be operated at engine oil temperature down to -50°C.

Figure 5-1. Instrument markings (Sheet 2 of 3)

206075-113-2



FUEL QUANTITY

0 to 65 Low Fuel



GAS PRODUCER TACHOMETER INDICATOR



105 Percent Maximum



62 to 105 Percent Continuous Operation

106 Percent Permissible for 15 Seconds

206075-113-3

Figure 5-1. Instrument markings (Sheet 3 of 3)

b. Maximum wind for hovering is 35 knots crosswind and 30 knots tailwind.

c. Maximum wind for mooring is 65 knots parallel to the ground in any direction.

5-8. Towing Limitations.

The maximum gross weight for towing the helicopter is 3000 pounds on all surfaces.

Section III. POWER LIMITS

5-9. Engine Limitations.

The engine limitations consist of torque, turbine outlet temperature, and rpm. (Refer to figure 5-1). If N2 limit is exceeded, entry on DA Form 2408-13 must include duration and torque indication.

5-10. Fuel Operation Limits.

a. **Standard Fuel.** No restrictions are imposed when JP-4 is used.

b. **Alternate Fuel.** JP-5, JP-8, Jet A and Jet A-1 are restricted to an ambient temperature range of -18°C to +52°C. A deceleration check must be performed prior to the first flight of each day. If autorotations are to be performed, a deceleration check will be done prior to each flight. Refer to para 8-23.3.

NOTE

Engine starting difficulties may be encountered if alternate fuels are used at ambient temperatures below +5°C (39°F).

c. Deleted.

d. **Emergency Fuel Aviation Gasoline (MIL-G-5572) without Tricresyl Phosphate (TCP).**

(1) The helicopter shall not be flown when emergency fuel has been used for a total accumulated time of 6 hours. Entry on remarks section of DA Form 2408-13 is required for each time emergency fuel is used.

(2) Practice autorotation is prohibited using emergency fuel.

5-11. Starter Limits.

a. **Starter Engage Time.** If a rise in TOT does not occur during the first 20 seconds, starter engage time is limited to the following:

EXTERNAL POWER

BAT POWER

25 seconds ON
30 seconds OFF
25 seconds ON
30 seconds OFF
25 seconds ON
30 minutes OFF

40 seconds ON
60 seconds OFF
40 seconds ON
60 seconds OFF
40 seconds ON
30 minutes OFF

b. **Starter Engage Time.** If rise in TOT occurs during the first 20 seconds, starter engage time is limited to the following:

EXTERNAL/BAT POWER

1 minute ON
1 minute OFF
1 minute ON
1 minute OFF
1 minute ON
30 minutes OFF

5-12. Engine Starting Limitations.

During starting if N1 does not reach 58 percent in a total time of 45 seconds (or 60 seconds below 10°C FAT), close throttle and press starter switch until TOT is below 200°C. Starter engage time limits in paragraph 5-11, a and b above, do not apply to engine starting limitations should abort start procedures become necessary.

5-12.1. Health Indicator Test (HIT).

The HIT is the method by which the aviator in day-to-day flying monitors the aircraft engine condition. This is accomplished by the aviator selecting a N1 speed (%) predicated upon the existing OAT. The TOT must then be compared to a predicted value (Baseline TOT) within a certain tolerance. TOT variation from baseline values are logged by the aviator. This log is part of the air-

craft records and is in aid to the maintenance personnel in monitoring performance trends and in troubleshooting on the engine. When the difference between the recorded TOT and the baseline TOT is $\pm 20^{\circ}\text{C}$ or greater, an entry on DA Form 2408-13 will be made to notify maintenance. A difference of $\pm 40^{\circ}\text{C}$ or greater is cause for grounding the aircraft until troubleshooting determines the cause for the high TOT.

Section IV. LOADING LIMITS

5-13. Center of Gravity Limitations.

Refer to center of gravity chart in Chapter 6 (figure 6-5).

5-14. Weight Limitations.

The maximum gross weight for this helicopter is 3200 pounds.

Section V. AIRSPEED LIMITATIONS

5-15. Airspeed Limitations.

a. Refer to airspeed operating limits chart (figure 5-2) for forward airspeed limits.

b. Sideward flight limits are 35 knots.

c. Rearward flight limits are 30 knots.

d. Recommend maximum indicated airspeed for autorotation is 100 knots.

e. Maximum indicated airspeed with any door removed is 100 knots.

5-16. Cockpit/Cabin Door Restrictions.

a. Helicopter will not be flown with only one cockpit door or one cabin door removed.

b. Whenever any OH-58C helicopter is operated without its cabin doors:

(1) All soundproof blankets must be in serviceable condition and firmly attached.

(2) After compliance with MWO 55-1520-228-30-30. Rear cushions (bottom and back) may remain installed provided seat belts are installed properly fastened to shoulder harness (refer to figure 2-10) and tightened.

(3) Loose equipment or components must be removed or secured.

Section VI. MANEUVERING LIMITS

5-17. Aerobatic Maneuvers.

Aerobatic maneuvers are prohibited.

5-18. Control Movements.

CAUTION

For gross weights greater than 3000 lbs and density altitudes greater than sea level, the directional control margin may

be significantly reduced while hovering in winds from the right greater than 20 knots or for right sideward flight at speeds greater than 20 knots.

Abrupt control movements, including rapid and repetitive anti-torque pedal reversals, are prohibited to avoid excessive stresses in the structure. This restriction in no way limits normal control application.

5-18.1. Hovering Limitations. Ten percent of total pedal travel, full right to full left, is considered adequate for safe control. The rearward airspeed limit is 30 knots and sideward limit is 35 knots except that control is marginal for certain combinations of relative wind velocity and azimuth angles (measured clockwise from the nose of the helicopter). See Chapter 8 for a description of the marginal wind velocity and azimuth angles.

5-19. Flight Restrictions At Low "G's".

Flight at less than +0.5 "G's" is prohibited.

5-20. Flight Restrictions For Practice Autorotation Landings.

Practice autorotation landings may be accomplished subject to the following limitations:

a. A qualified OH-58 IP must be in position to take control of the aircraft.

b. Touchdown autorotations downwind are prohibited.

c. Reported surface winds must not exceed 20 knots (figure 5-3).

d. Surface crosswind component must not exceed 10 knots. Wind gust spread must not exceed 10 knots.

e. Touchdown rotor RPM must not be less than 64%.

f. Ground speed at touchdown must not exceed 5 knots.

g. Airspeed during glide shall not be less than that established for minimum rate of descent.

CAUTION

In any event, relatively long ground runs with the collective up, or any tendency to float for long distance prior to skid contact should be avoided. If vibrations are encountered after touchdown immediately lowering of the collective is recommended.

h. Upon ground contact, collective pitch must be reduced smoothly to bottom stop without delay while maintaining cyclic pitch near center position. Application of aft cyclic should be avoided.

5-20.1. Flight Restriction of Tail Rotor Control.

Helicopter will not be flown unless the Primary Directional Anti-Torque System and the Vulnerability Reduction (backup) Directional Anti-Torque system are both operable.

5-20.2. Flight Restriction for High Power.

CAUTION

In aircraft equipped with IR exhaust stacks, rate of climb in excess of 1000 ft/min may result in divergent aircraft pitch oscillation which can reach 20 to 30 degree attitudes. This divergence can be alleviated by either increasing airspeed during steady climbs or decreasing rate of climb. Climb rates in excess of 1000 ft/min should be avoided.

AIRSPPEED OPERATING LIMITS **ALL CONFIGURATIONS** **100% RPM**

**AIRSPPEED
 OPERATING
 LIMITS
 OH-58C
 T63-A-720**

EXAMPLE

WANTED

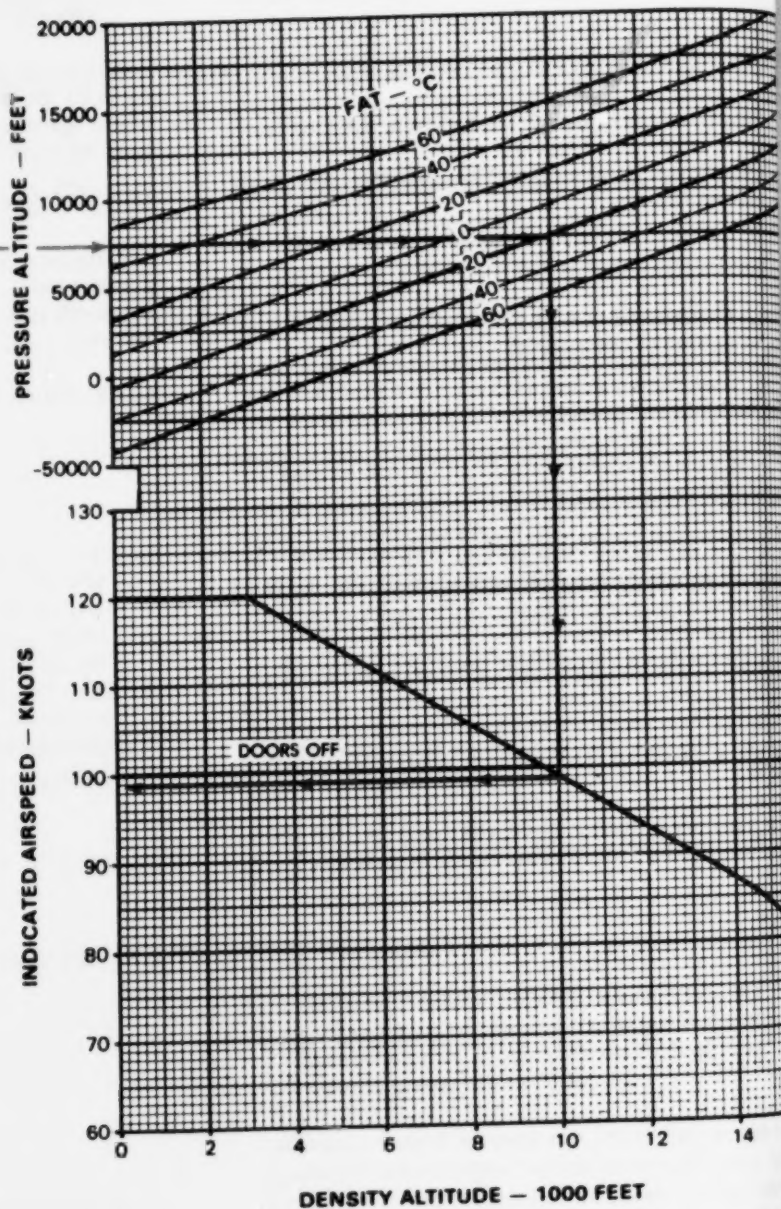
INDICATED AIRSPEED
 AND DENSITY ALTITUDE

KNOWN

PRESSURE ALTITUDE = 7500 FEET
 FAT = +20°C

METHOD

ENTER PRESSURE ALTITUDE HERE
 MOVE RIGHT TO FAT
 MOVE DOWN TO CONFIGURATION
 MOVE LEFT, READ INDICATED
 AIRSPEED = 99 KNOTS



DATA BASIS: DERIVED FROM BELL HELICOPTER TEXTRON FLIGHT TEST

Figure 5-2. Airspeed operating limits chart

5-20.3. Possible Loss of Necessary Instruments For Autorotation.

A total electrical failure may preclude use of the main rotor RPM gauge and turn rate indicator and

operation on battery power only may be unreliable. The OH-58C generator is run by the engine and starting the OH-58C causes significant battery drain. Due to this fact, the possibility of losing the use of the RPM gauge during engine failure exists.

Section VII. ENVIRONMENTAL RESTRICTIONS

5-21. Flight Under Instrument Meteorological Conditions (IMC).

The helicopter is restricted to visual flight conditions. Flight into instrument meteorological conditions will be conducted on an emergency basis only.

5-21.1 Flight In Rain.

Flight in moderate to heavy rain might cause water sheeting on the windshield which may result in severely restricted visibility.

5-21.2. Flight Restrictions with Reverse Flow Inlet Fairings.

Engine power is reduced approximately 4% with reverse flow inlet fairings installed. Refer to Chapter 7 for more detailed information and performance limitations.

5-22. Flight Restrictions in Falling or Blowing Snow.

Flight in falling or blowing snow is prohibited except for those helicopters with improved air induction systems and with provisions for reverse flow inlet fairing. Helicopters having the above features may be flown in falling or blowing snow provided reverse flow inlet fairings are installed and the following criteria is met.

a. Visibility reduced by snow must be at least 1/2 mile.

b. Prior to initial takeoff and each subsequent takeoff, inspect the helicopter as follows:

(1) Inspect inlet for possible accumulations of snow, slush or ice. Accumulations must be removed from the interior of the reverse flow inlet (hand removal is acceptable).

(2) Inspect the engine plenum chamber through the plexiglass windows (a flashlight may be required) on each side of the inlet cowl for snow, slush or ice, paying particular attention to the firewalls, rear face of the particle separator, bottom corners and protruding surfaces such as guide vanes, etc.

(3) Visually inspect the plastic particle separator eductor tubes on each side of the engine fairing for obstructions and snow. A thin film of ice about the interior of each tube is acceptable. External ice adjacent to the eductor tubes is acceptable.

5-23. Flight Over Salt Water.

a. Prolonged hovering over salt water which results in spray ingestion, indicated by spray on the windshield, should be avoided.

b. Salt spray ingestion in turbine engines may result in a deterioration in performance as well as a loss in compressor stall margin. Following salt water ingestion, an entry shall be made on DA Form 2408-13.

All data on page 5-8.2 including figure 5-2.1 deleted.

Section VIII. HEIGHT VELOCITY

5-24. Height Velocity.

The minimum height for safe landing after engine failure chart (Figure 5-4) is based on an extrapolation of test data. The lower chart is applicable for the gross weight and density altitude range depicted by the green (safe) area of the upper chart. The yellow (caution) area of the lower chart indi-

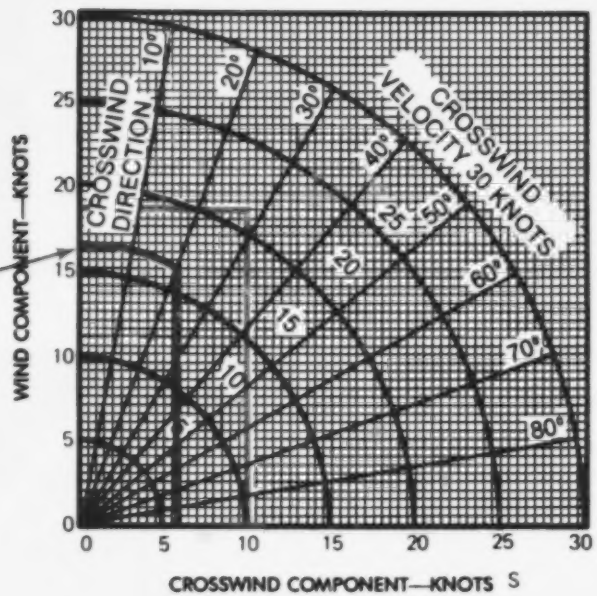
cates an area from which a safe autorotational landing can be made, but continuous operation in this area should be avoided. If an engine failure should occur, the emergency procedures relating to engine failures in Chapter 9 should be observed.

EXAMPLE

WANTED
CROSSWIND COMPONENT

KNOWN
WIND VELOCITY = 17 KNOTS
CROSSWIND DIRECTION (RELATIVE
TO TOUCHDOWN HEADING) = 20°

METHOD
ENTER WIND VELOCITY HERE
FOLLOW 17 KNOT CURVE TO CROSS WIND
DIRECTION FROM THAT POINT MOVE DOWN
READ CROSS WIND COMPONENT 6 KNOTS



G206099-3

Figure 5-3. Practice Autorotation Landing Limits Crosswind Components

MINIMUM HEIGHT FOR SAFE LANDING AFTER ENGINE FAILURE

MINIMUM HEIGHT
OH-58C
T63-A-720



EXAMPLE A

WANTED

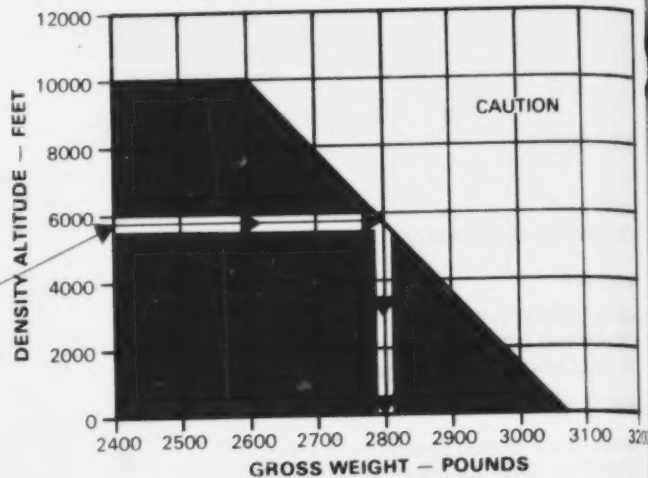
MAXIMUM GROSS WEIGHT RESTRICTION FOR SAFE
LANDING AFTER ENGINE FAILURE

KNOWN

DENSITY ALTITUDE — 5700 FEET

METHOD

ENTER DENSITY ALTITUDE HERE
MOVE RIGHT TO DIAGONAL LINE
MOVE DOWN, READ GROSS WEIGHT = 2800 LBS



EXAMPLE B

WANTED

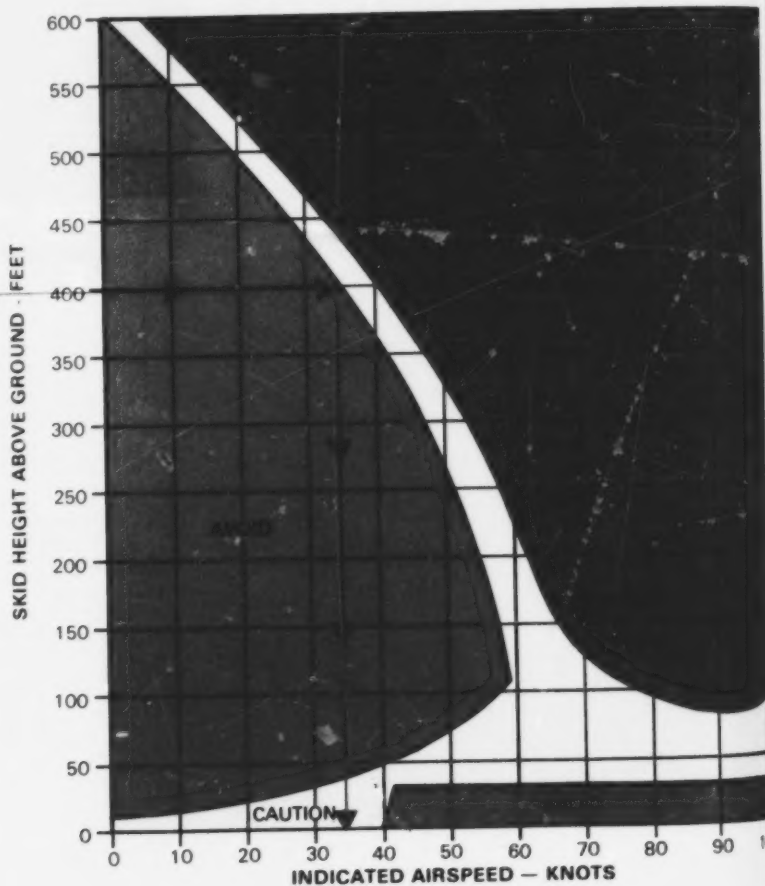
MINIMUM INDICATED AIRSPEED
FOR SAFE LANDING (WITHOUT
AIRCRAFT DAMAGE) AFTER
ENGINE FAILURE

KNOWN

SKID HEIGHT ABOVE GROUND = 400 FEET

METHOD

ENTER SKID HEIGHT HERE
MOVE RIGHT TO CRITICAL POINT
ON HEIGHT VELOCITY CURVE
MOVE DOWN, READ INDICATED
AIRSPEED = 35 KNOTS (MINIMUM)



DATA BASIS: DERIVED FROM FLIGHT TEST OF SIMILAR TYPE AIRCRAFT

Figure 5-4. Minimum height for safe landing after engine failure chart.

All data on pages 5-11 and 5-12 has been deleted, including Figure 5-5 Control Margin Chart, Sheet 1 of 2 and Sheet 2 of 2.

CHAPTER 6

WEIGHT/BALANCE AND LOADING

Section I. GENERAL

6-1. General.

Chapter 6 contains sufficient instructions and data so that an aviator knowing the basic weight and moment of the helicopter can compute any combination of weight and balance.

6-2. Class.

Army Model OH-58C is in Class 2. Additional directives governing weight and balance of Class 2 aircraft forms and records are contained in AR 95-16, TM 55-1500-342-23 and DA PAM 738-751.

6-3. Helicopter Station Diagrams.

Figure 6-1 shows the helicopter reference datum lines, fuselage stations, buttlines, and waterlines. The primary purpose of the figure is to aid personnel in the computation of helicopter weight/balance and loading.

6-4. Loading Charts.

a. Information. The loading data contained in this chapter are intended to provide information necessary to work a loading problem for the helicopters to which this manual is applicable.

b. Use. From the figures contained in this chapter, weight and moment are obtained for all variable load items and are added to the current basic weight and moment (DD Form 365C) to obtain the gross weight and moment.

(1) The gross weight and moment are checked on figure 6-5 to determine the approximate center of gravity (cg).

(2) The effect on cg by the expenditures in flight of such items as fuel, etc., may be checked by subtracting the weights and moments of such items from the takeoff weight and moment and checking the new weight and moment on the Center of Gravity Limits Chart.

(3) If the weight and moment lines intersect between the forward and aft limit lines, the helicopter is within flight limits.

NOTE

This check should be made to determine whether or not the cg will remain within limits during the entire flight.

Section II. WEIGHT AND BALANCE

6-5. Weight and Balance Records.

Weight and balance forms are maintained in the

helicopter historical file. Refer to Section VIII of this chapter for additional information on DD Forms 365A, C, and F.

Section III. PERSONNEL

6-6. Personnel Moments.

Refer to figure 6-3 to compute pilot, passenger and copilot observer moments.

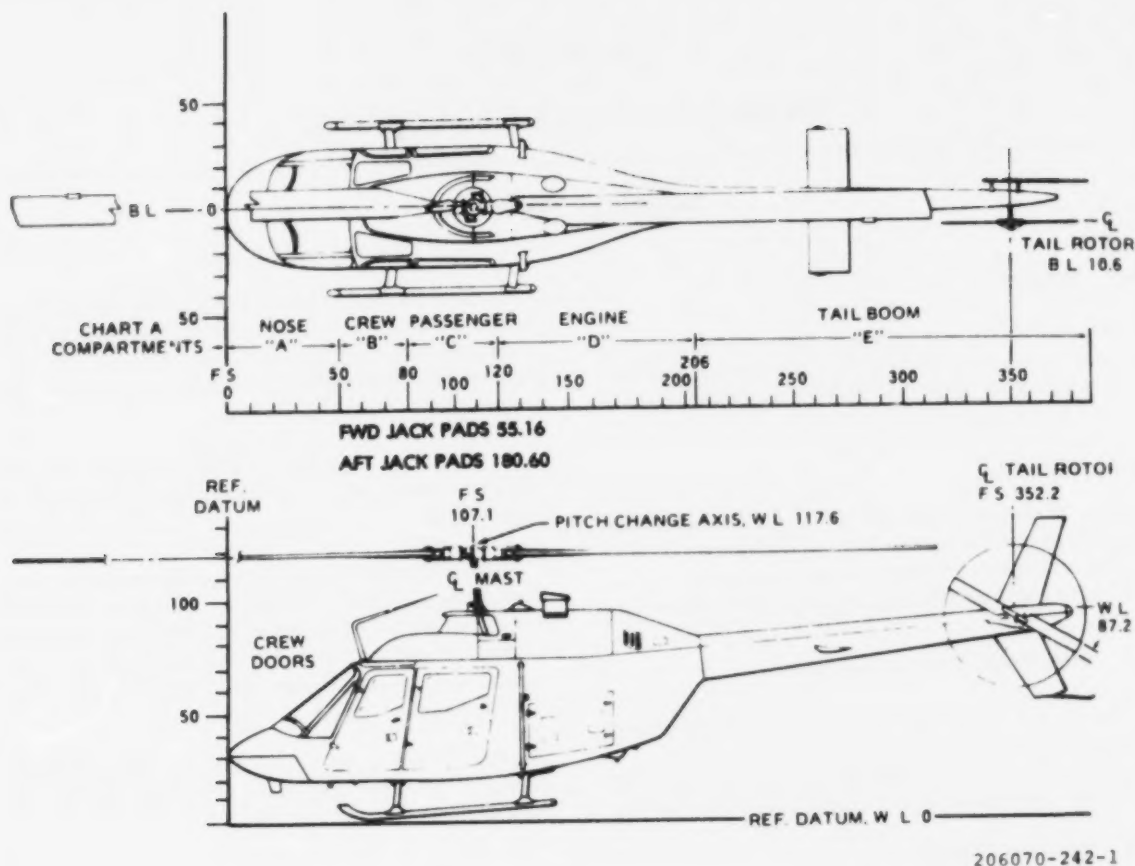


Figure 6-1. Helicopter station diagram

Section IV. MISSION EQUIPMENT

Not Applicable

Section V. CARGO LOADING

6-7. Cargo Loading.

Refer to figure 6-2 for cargo loading.

6-7.1 Cargo Platform (Figure 6-2.1)

CAUTION

To prevent damage to the floor of the passenger compartment, no cargo or baggage that may damage the floor will be placed on the floor of the helicopter. The

cargo platform will be installed whenever cargo is to be carried.

The cargo platform will be installed in the passenger area for cargo handling. The platform is a two-piece construction of plywood sheeting. Provisions are made for mounting to existing fuselage hardware. The strength of the cargo tiedowns on the cargo platform is 2,100 pounds.

Section VI. FUEL/OIL

6-8. Fuel Data.

Refer to figure 6-4 for fuel quantity, weight, and moment.

6-9. Oil Data.

For weight and balance purposes, engine oil is a part of basic weight.

Section VII. CENTER OF GRAVITY

6-10. Center of Gravity.

Refer to figure 6-5 for center of gravity limits.

6-11. Deleted.

Section VIII. DD FORM 365

6-12. DD Form 365A — Basic Weight Check List.

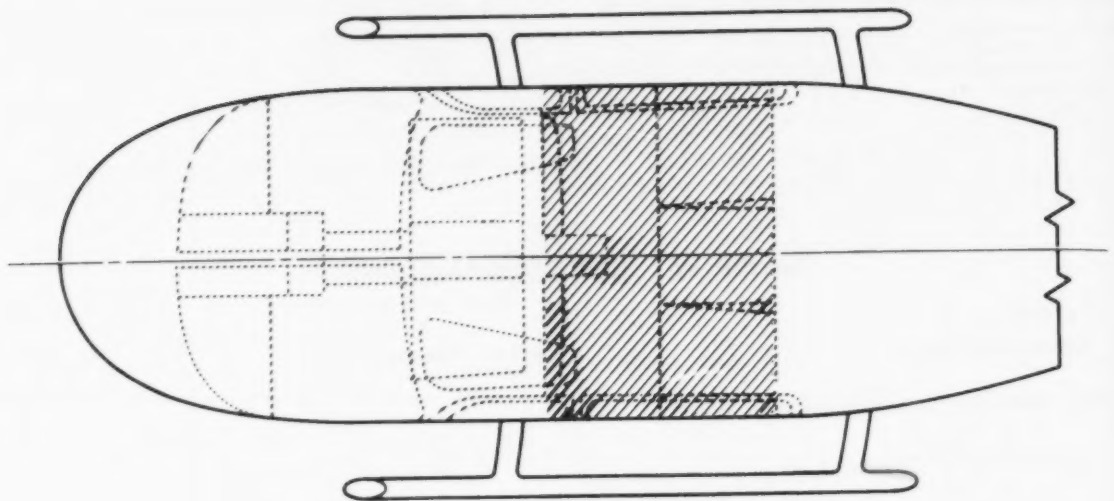
The form is a tabulation of equipment that is, or may be, installed and for which provision for fixed stowage has been made in a definite location. The form gives the weight, arm, and moment/100 of individual items for use in correcting the basic weight and moment on DD Form 365C as changes are made in this equipment.

6-13. DD Form 365C — Basic Weight and Balance Record.

The form is a continuous history of the basic weight and moment resulting from structural and equipment changes. At all times the last entry is considered current weight and balance status of the basic helicopter. Figure 6-6 shows a sample DD Form 365C.

6-14. DD Form 365F — Weight and Balance Clearance Form F (Transport).

a. General. The form is a summary of actual disposition of the load in the helicopter. It records the



VIEW LOOKING DOWN

CARGO SPACE AVAILABLE



Maximum cargo weight not to exceed 950 pounds
or 100 pounds per square foot.

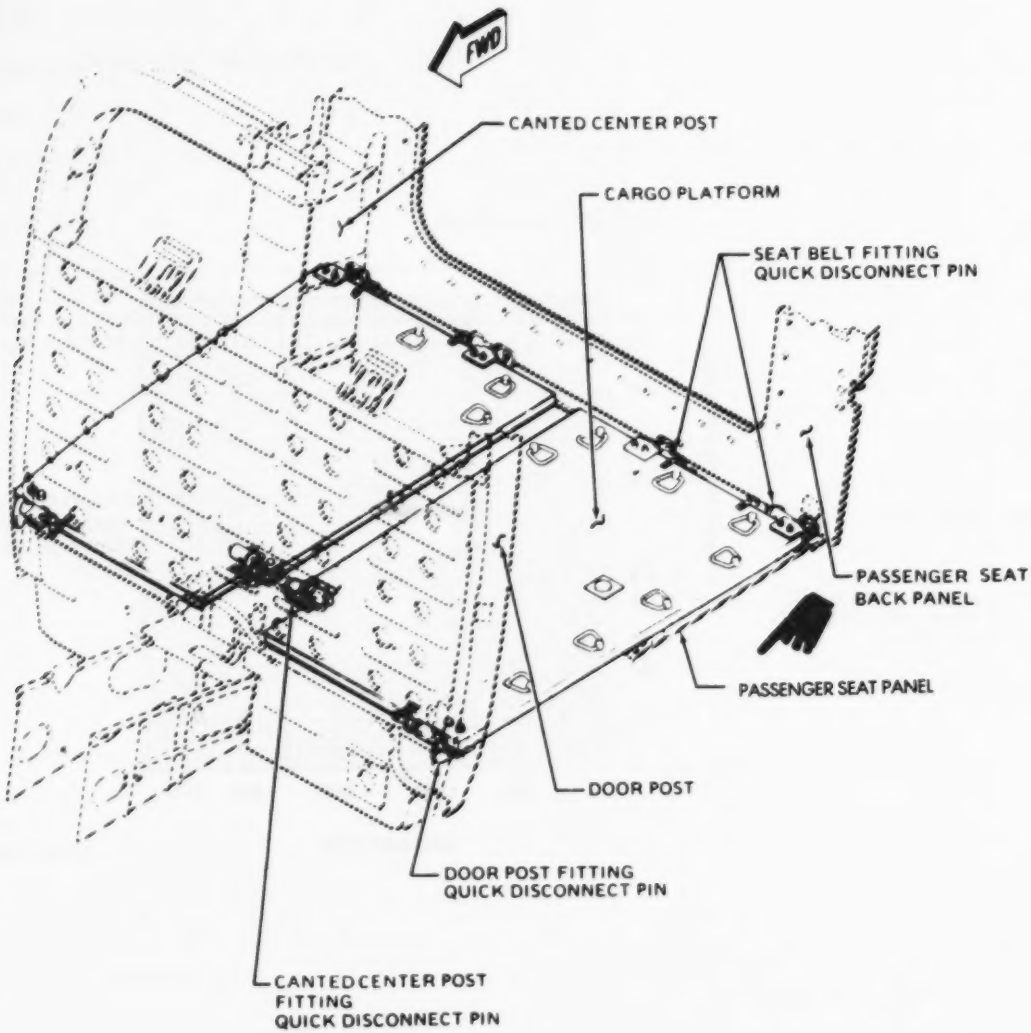
CAUTION

No cargo shall be carried in the avionics compartment.

Maximum single box cargo size is 33.0 x 23.4 x 44.0 inches.
Maximum cargo size either side of canted center post is 33.0 x
27.5 x 18.5 inches.

206900-166A

Figure 6-2. Cargo space



G206900-12

Figure 6-2.1 Cargo platform installation



EXAMPLE

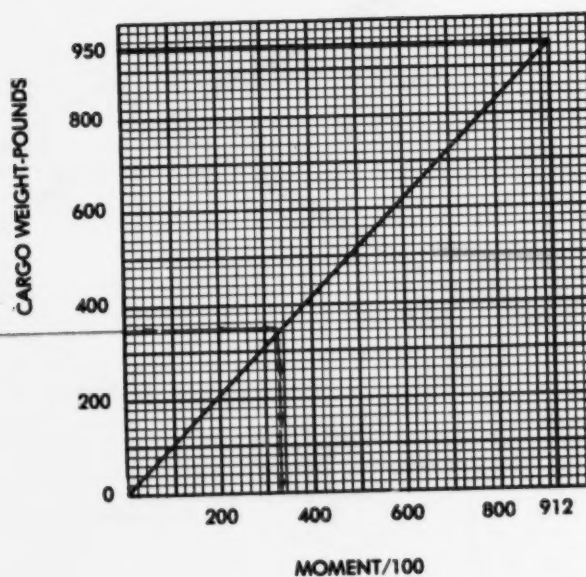
WANTED
CARGO MOMENT

KNOWN
CARGO WEIGHT 350 POUNDS

METHOD

MOVE RIGHT FROM 350 TO DIAGONAL
LINE. THEN MOVE DOWN AND READ
325 ON THE MOMENT SCALE.

CARGO LOADING



CARGO PLATFORM
WEIGHS 32 POUNDS
WITH A MOMENT
OF 30

209900-823

Figure 6-2.2 Cargo Loading

SEATING ARRANGEMENT

☐ ☐ B PILOT OR COPILOT
☐ ☐ C PASSENGERS

EXAMPLE:

WANTED

PERSONNEL MOMENT FOR ONE PASSENGER

KNOWN

PERSONNEL WEIGHT OF 200 POUNDS IN BACK SEAT.

METHOD

MOVE RIGHT FROM 200 POUNDS TO BACK SEAT LINE. PROJECT DOWN TO READ 208 ON MOMENT/100 SCALE

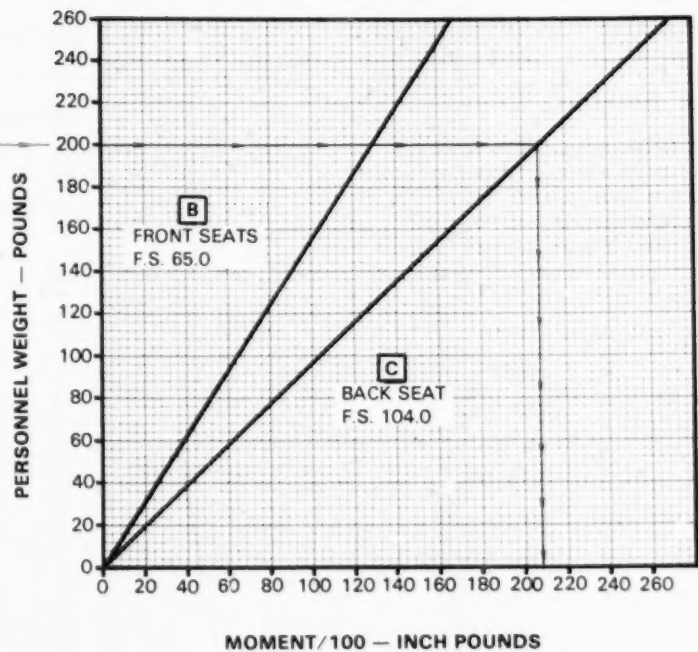


Figure 6-3. Personnel moment chart

FUEL LOADING CHART MODEL OH-58C

EXAMPLE

WANTED

MOMENT FOR KNOWN FUEL QUANTITY

KNOWN

QUANTITY = 50 GALLONS (325 LBS.
JP-4)

METHOD

MOVE RIGHT FROM 325 LBS
ON JP-4 SCALE TO INTERSECT JP-4
DIAGONAL CURVE. MOVE
DOWN FROM THIS POINT TO
READ 370 ON THE MOMENT / 100 SCALE

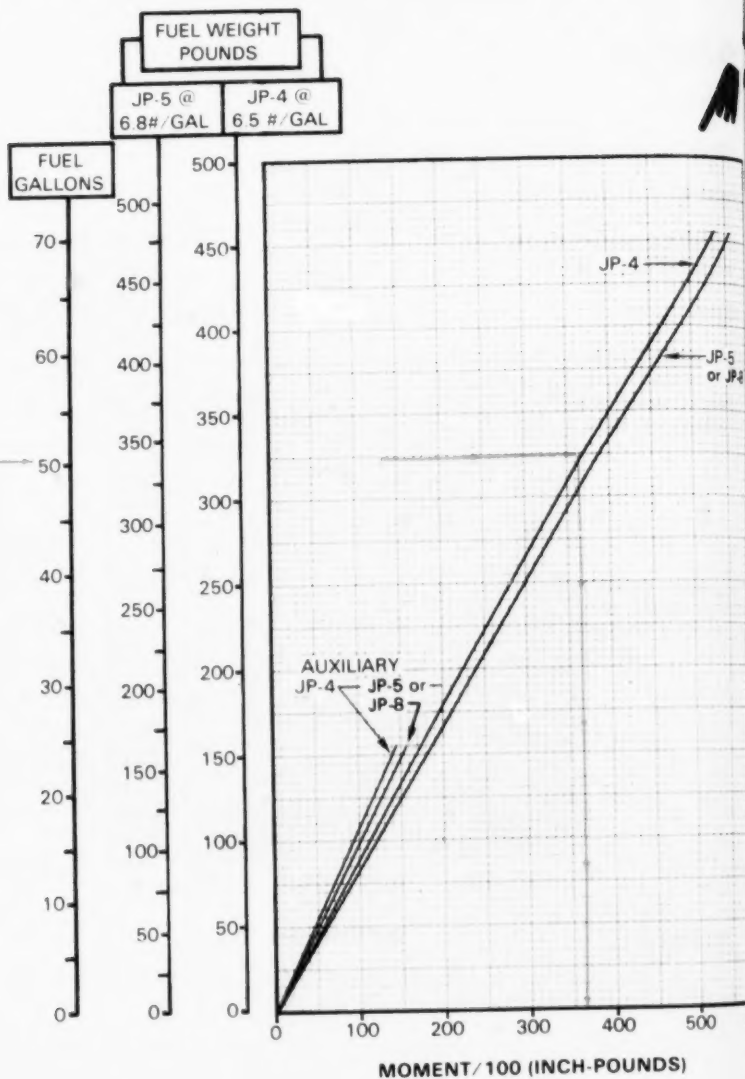


Figure 6-4. Fuel loading chart

CENTER OF GRAVITY LIMITS

C.G.
CHART
OH-58C

EXAMPLE

WANTED

DETERMINE APPROXIMATE CENTER
OF GRAVITY FOR KNOWN WEIGHT
AND MOMENT.

KNOWN

GROSS WEIGHT 2850 POUNDS
MOMENT/100 = 3150 INCH POUNDS

METHOD

MOVE RIGHT FROM 2850 POUNDS
TO 3150 IN-LB DIAGONAL LINE
FROM THIS POINT MOVE DOWN TO
READ 110.5 ON CENTER OF GRAVITY
SCALE

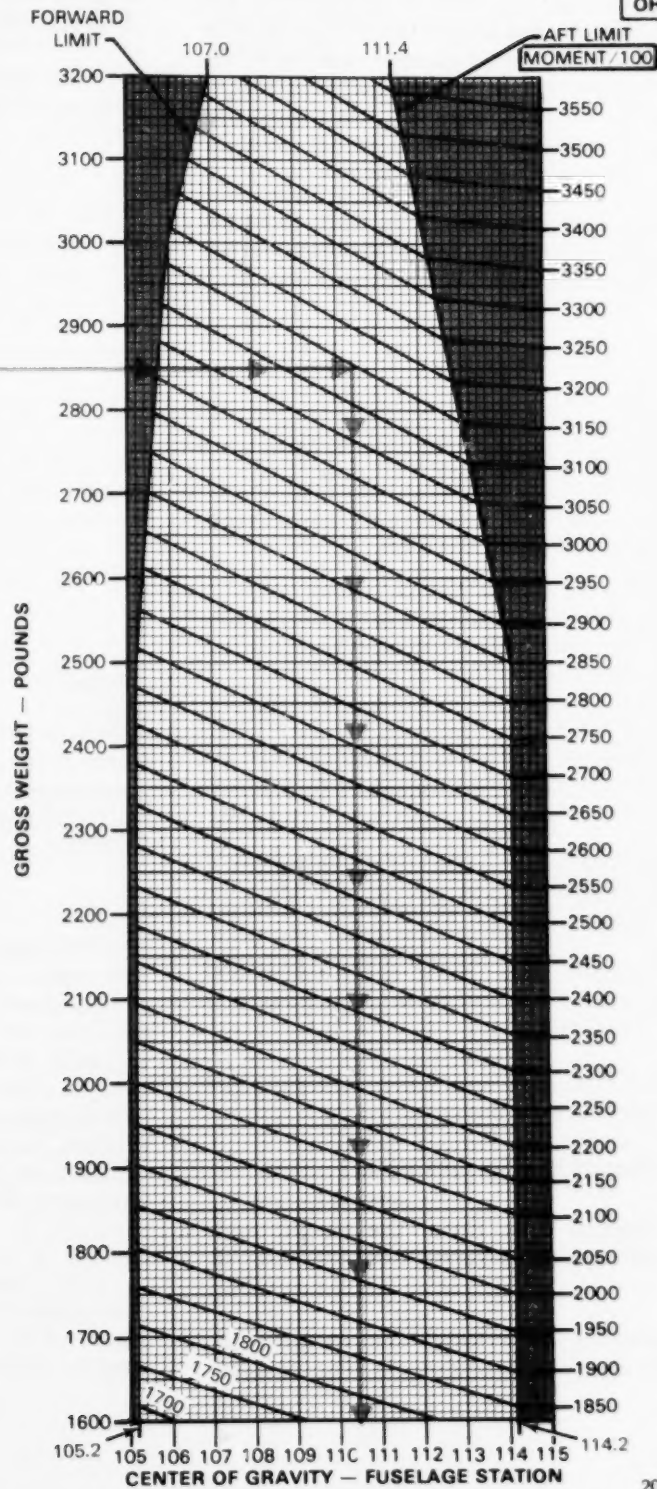


Figure 6-5. Center of gravity limit chart

balance status of the helicopter, step-by-step. It serves as a worksheet on which to record weight and balance calculations, and any corrections that must be made to ensure that the helicopter will be within weight and cg limits. The form is required only when the loading is such as to seriously effect the flying characteristics and safety of the helicopter and in all cases where alternate loading is employed.

b. *Form Preparation.* Specific instructions for filling out the form is given in the following paragraphs. Figure 6-7 shows the results of the instructions.

NOTE

Reference 1, 2, etc., are references to item 1, 2, etc., on DD Form 365F.

(1) Fill in the necessary identifying information at the top of the form.

NOTE

Enter moment/100 values from figures within this chapter throughout the form.

(2) Reference 1 — Enter the helicopter basic weight and moment/100. Obtain these figures from the last entry on DD Form 365C — Basic Weight and Balance Record.

(3) Reference 2 — Enter the gallons, weight and moment/100 of "Oil" obtained from "Oil Data", Chapter 6, Section VI.

(4) Reference 3 — Enter the number and weight and moment/100 of crew. Use actual crew weights if available.

(5) Reference 4 — Enter weight and moment/100 of crew's baggage.

(6) Reference 5 — Not applicable.

(7) Reference 6 — Enter the weight and moment/100 of emergency equipment, if applicable.

(8) Reference 7 — Enter the weight and moment/100 of any extra equipment, if applicable.

(9) Reference 8 — Enter the sum of the weights and moment/100 of reference 1 through 7 to obtain "operating weight".

(10) Reference 9 — Enter the number of gallons, weight and moment/100 of takeoff fuel.

NOTE

List under REMARKS the type of fuel, tanks concerned and the amount of fuel in each tank. If the external or internal fuel is carried make appropriate entries to that effect in space provided.

(11) Reference 10 — Not applicable.

(12) Reference 11 — Enter the sum of the weight and moment/100 for reference 8 through 10 to obtain "Total Helicopter Weight".

(13) Deleted.

(14) Reference 12 — Using the same compartment letter designation as shown in Figure 6-1, enter the number and weight and moment/100 of passengers (figure 6-3) and/or cargo (baggage, mail, etc.) (figure 6-2). Use actual passenger weights, if available. Enter the total for each compartment in the weight and moment/100 columns.

NOTE

The sum of compartment totals shall not exceed the "Allowable Load" determined in the "Limitations" table.

(15) Reference 13 — Enter the sum of the weight and moment/100 of reference 11 and the compartment totals from reference 12 opposite "Take-Off Condition" (uncorrected). (At this point, if not already done, calculate and enter the moment/100 values for references 1 through 12.)

(16) Check the weight figure (reference 13) and the moment/100 figure (reference 13) by means of figure 6-5 (Center of Gravity Limit Chart) to verify that the indicated cg is within allowable limits.

(17) Reference 14 — If changes in weight or distribution of load are required, indicate necessary adjustment by proper entries in the "Corrections" table in lower left corner of the form as follows (not applicable.)

(a) Enter a brief description of the adjustment made in the column marked "Item".

(b) Add all the weights and all the moment decreases. Insert the total in the space opposite "Total Weight Removed".

(c) Add all the weights and all the moment increases. Insert the total in the space opposite "Total Weight Added".

(d) Subtract the smaller from the larger of the two totals and enter the difference (with applicable plus or minus sign) opposite "Net Difference".

(e) Transfer these "Net Difference" figures to the space opposite reference 14.

(18) Reference 15 — Enter the sum of or difference between references 13 and 14. Recheck to verify that these figures do not exceed allowable limits.

(19) Reference 16 — Determine the take-off cg position by referring to figure 6-5. Enter this figure in the space provided opposite "Take-Off CG".

(20) Reference 17 — Estimate the weight of fuel and any other items which may be expended before landing. Enter figures together with moment/100 in the space provided. To estimate the amount of fuel expended, perform the following calculation:

(a) Subtract the weight and moment/100 of the estimated fuel on board at landing from the weight and moment/100 of the fuel on board at takeoff.

(b) Enter the above differences in the fuel spaces opposite reference 17.

EXAMPLE	GAL	WEIGHT	MOMENT
Fuel on board at take-off	70	455	532
Less fuel estimated on board at landing		-130	-145
Fuel expended (enter in spaces opposite reference 17).		325	387

NOTE

Reserve fuel will be considered as "on-board weight" when determining "Estimated Landing Condition".

(21) Reference 18 — Enter the weight of "Air Supply Load" to be dropped before landing and its moment/100 (if applicable).

(22) Reference 19 — Not applicable.

(23) Reference 20 — Enter the difference in weight and moment/100 between reference 15 and the sum of reference 17 and 18.

(24) Reference 21 — By again referring to figure 6-5 (Center of Gravity Limit Chart) determine the estimated landing cg position. Enter this figure opposite "Estimated Landing CG".

NOTE

Check the landing cg figure with permissible cg figures in "Limitations" block. The landing cg must be within the range shown.

(25) The necessary signature shall appear at the bottom of the form.

CHART C—BASIC WEIGHT AND BALANCE RECORD										FOR USE IN Y.O. 104 AR 61-18-4	
(CONTINUOUS HISTORY OF CHANGES IN STRUCTURE OR EQUIPMENT AFFECTING WEIGHT AND BALANCE)										PAGE NO.	
OH-58C				SERIAL NO. SAMPLE ONLY						RUNNING TOTAL BASIC AIRPLANE	
DATE	ITEM NO.		DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE						WEIGHT	MOMENT
	*	UT		ADDED (+)			REMOVED (-)				
				WEIGHT	ARM	MOMENT	WEIGHT	ARM	MOMENT		
7-12-77			BASIC							1896	22048
EXAMPLE ONLY											

* Enter constant used below line

DD FORM 1 SEP 54 365 C

* Balance computer index

PREVIOUS EDITIONS OF THIS FORM MAY BE USED UNTIL STOCKS ARE EXHAUSTED.

16-77070-1 G. I. GOVERNMENT PRINTING OFFICE

206

WEIGHT AND BALANCE CLEARANCE FORM F
TRANSPORT
(USE REVERSE FOR TACTICAL MISSIONS)

Check Beforeman
BAF Form 200
Rev. 1-55 (100)
BOM 5-51 (500)

FOR USE IN
T.O. 1-19-40
A9 00-18-00

DATE 3-5-79		AIRCRAFT TYPE OH-58C		FROM		HOME STATION	
MISSION/TRIP/FLIGHT NO. OBSERVATION		SERIAL NO. SAMPLE ONLY		TO		PILOT	

LIMITATIONS				ITEM	WEIGHT	INDEX OR BOM: 100
CONDITION	TAKEOFF	LANDING	LIMITING WING FUEL			
ALLOWABLE GROSS WEIGHT				1. BASIC AIRCRAFT (From Chart C)	1898	2205
TOTAL AIRCRAFT WEIGHT (Ref. 11)				2. OIL ()		
OPERATING WEIGHT PLUS ESTIMATED LANDING FUEL WEIGHT				3. CREW ()	280	247
OPERATING WEIGHT (Ref. 8)				4. CREW'S BAGGAGE	40	42
ALLOWABLE LOAD (Ref. 10) (Use SMALLEST value)				5. STEWARD'S EQUIPMENT		
PERMISSIBLE C.G. TAKEOFF	FROM	TO (% MAC or %N)		6. EMERGENCY EQUIPMENT		
PERMISSIBLE C.G. LANDING	FROM	TO (% MAC or %N)		7. EXTRA EQUIPMENT		
				8. OPERATING WEIGHT	2329	2514
				9. TAKEOFF FUEL ()	70	532
				10. WATER AND FLUID ()		
				11. TOTAL AIRCRAFT WEIGHT	2784	3046

DISTRIBUTION OF ALLOWABLE LOAD (PAYLOAD)					
UPPER COMPARTMENTS			LOWER COMPARTMENTS		
COMPT	PASSENGERS	CARGO	COMPT	PASSENGERS	CARGO
NO.	WEIGHT		NO.	WEIGHT	
A					
B					
C	1	200			
D					
E					
F					
G					
H					
I					
J					
K					
L					
M					
N					
O					
P					
FWD BULKY					
AFT BULKY					

REMARKS
JP-4 INTERNAL FUEL 70 GAL.

TOTAL FREIGHT

TOTAL MAIL

COMPUTER PLATE NUMBER (If used)

1. 2 - for constant used.
2. Enter values from current applicable T.O.
3. Applicable to gross weight (Ref. 13).
4. Applicable to gross weight (Ref. 14).
5. Ref. 9 minus Ref. 17.

CORRECTIONS (Ref. 14)				13. TAKEOFF CONDITION (Unadjusted)	
COMPT	ITEM	WEIGHT	INDEX OR BOM		
				2984	3254
				2984	3254
				109.1 IN	
				315	327
				2659	2867
				107.8 IN	

14. CORRECTIONS (If required)

15. TAKEOFF CONDITION (Adjusted)

16. TAKEOFF C.G. IN % W.A.C. OR IN

17. LBS. FUEL

18. LBS. AIR SUPPLY LOAD DROPPED

19. WING VARIABLES

20. ESTIMATED LANDING CONDITION

21. ESTIMATED LANDING C.G. IN % W.A.C. OR IN

COMPUTED BY

/SIGNED/ SIGNATURE

WEIGHT AND BALANCE AUTHORITY

/SIGNED/ SIGNATURE

PILOT

/SIGNED/ SIGNATURE

TOTAL WEIGHT REMOVED - -

TOTAL WEIGHT ADDED + +

NET DIFFERENCE (Ref. 16)

DD FORM 365F

16-47100-6 U.S. GOVERNMENT PRINTING OFFICE

209900-814

Figure 6-7. DD Form 365F Weight and Balance Clearance Form F (Transport) (Sample)

CHAPTER 7
PERFORMANCE DATA

Section I. INTRODUCTION

7-1. Purpose.

The purpose of this chapter is to provide the best available performance data for the OH-58C helicopter. Regular use of this information will enable you to receive maximum safe utilization from the aircraft. Although maximum performance is not always required, regular use of this chapter is recommended for the following reasons.

- a. Knowledge of your performance margin will allow you to make better decisions when unexpected conditions or alternate missions are encountered.
- b. Situations requiring maximum performance will be readily recognized.
- c. Familiarity with the data will allow performance to be computed more easily and quickly.

d. Experience will be gained in accurately estimating the effects of variables for which data are not presented.

NOTE

The information provided in this chapter is primarily intended for mission planning and is most useful when planning operations in unfamiliar areas or at extreme conditions. The data may also be used inflight, to establish unit or area standing operating procedures, and to inform ground commanders of performance/risk tradeoffs.

7-2. Chapter 7 Index.

The following index contains a list of the sections and their titles, the figure numbers, subjects and page numbers of each performance data chart contained in this chapter.

INDEX		
Section	Subject	Page No.
I	Introduction	7-1
II	Temperature Conversion	7-5
	Figure 7-1. Deleted	
	Figure 7-2. Temperature Conversion Chart	7-9
III	Torque Available	7-10
	Figure 7-3. Maximum Torque (30 Minute Operation) Charts	
	Sheet 1 of 4, Engine Deice and Heater OFF	7-11
	Sheet 2 of 4, Engine Deice and Heater ON	7-12
	Sheet 3 of 4, Engine Deice and Heater OFF and Reverse Flow	
	Inlet Installed	7-13
	Sheet 4 of 4, Engine Deice and Heater ON and Reverse Flow	
	Inlet Installed	7-14

Index (Cont)

Section	Subject	Page No.
	Figure 7-4. Torque Available (Continuous Operation) Charts	
	Sheet 1 of 4, Engine Deice and Heater OFF	7-15
	Sheet 2 of 4, Engine Deice and Heater ON	7-16
	Sheet 3 of 4, Engine Deice and Heater OFF and Reverse Flow	
	Inlet Installed	7-17
	Sheet 4 of 4, Engine Deice and Heater ON and Reserve Flow	
	Inlet Installed	7-19
IV	Hover	7-20
	Figure 7-5. Hover Charts	
	Sheet 1 of 2, Hover Chart	7-21
	Sheet 2 of 2, Hover Chart	7-23
V	Takeoff	7-24
	Figure 7-6. Takeoff Chart	7-25
VI	Cruise	7-26
	Figure 7-7. Cruise Charts	
	Sheet 1 of 13, Pressure Altitude Sea Level to 2000 Ft, FAT = -30°C	7-27
	Sheet 2 of 13, Pressure Altitude 4000 Ft to 6000 Ft, FAT = -30°C	7-28
	Sheet 3 of 13, Pressure Altitude 8000 Ft to 14000 Ft, FAT = -30°C	7-29
	Sheet 4 of 13, Pressure Altitude Sea Level to 6000 Ft, FAT = -15°C	7-30
	Sheet 5 of 13, Pressure Altitude 8000 Ft to 14000 Ft, FAT = -15°C	7-31
	Sheet 6 of 13, Pressure Altitude Sea Level to 6000 Ft, FAT = 0°C	7-32
	Sheet 7 of 13, Pressure Altitude 8000 Ft to 14000 Ft, FAT = 0°C	7-33
	Sheet 8 of 13, Pressure Altitude Sea Level to 6000 Ft, FAT = +15°C	7-34
	Sheet 9 of 13, Pressure Altitude 8000 Ft to 14000 Ft, FAT = +15°C	7-35
	Sheet 10 of 13, Pressure Altitude Sea Level to 6000 Ft, FAT = +30°C	7-36
	Sheet 11 of 13, Pressure Altitude 8000 Ft to 14000 Ft, FAT = +30°C	7-37
	Sheet 12 of 13, Pressure Altitude Sea Level to 6000 Ft, FAT = +45°C	7-38
	Sheet 13 of 13, Pressure Altitude 8000 Ft to 14000 Ft, FAT = +45°C	7-39
VII	Drag	7-40
	Figure 7-8. Drag Chart	7-41
VIII	Climb — Descent	7-42
	Figure 7-9. Climb-Descent Chart	7-43
	Figure 7-10. Climb-Performance Charts	
	Sheet 1 of 2	7-45
	Sheet 2 of 2	7-47
IX	Idle Fuel Flow	7-48
	Figure 7-11. Idle Fuel Flow Chart	7-49

7.3. General.

The data presented covers the maximum range of conditions and performance that can reasonably be expected. In each area of performance, the effects of altitude, temperature, gross weight, and other parameters relating to that phase of flight are presented. In addition to the presented data, your judgment and experience will be necessary to accurately obtain performance under a given set of circumstances. The conditions for the data are listed under the title of each chart. The effects of different conditions are discussed in the text accompanying each phase of performance. Where practical, data are presented at conservative conditions. However, **NO GENERAL CONSERVATISM HAS BEEN APPLIED**. All performance data presented are within the applicable limits of the aircraft.

7.4. Limits.

Applicable limits are shown on the charts as red lines. Performance generally deteriorates rapidly beyond limits. If limits are exceeded, minimize the amount and time. Enter the maximum value and time above limits on DA Form 2408-13 so proper maintenance action can be taken.

7.5. Use of Charts.

a. *Chart Explanation.* The first page of each section describes the chart(s) and explains its uses.

b. *Color Coding.* Chart color codes are used as follows:

- (1) Green is used for example guidelines.
- (2) Red is used for limit lines.
- (3) Yellow is used for precautionary or time-limited operation.

c. *Reading the Charts.* The primary use of each chart is given in an example and a green guideline is provided to help you follow the route through the chart. The use of a straight edge (ruler or page edge) and a hard fine point pencil is recommended to avoid cumulative errors. The majority of the charts provide a standard pattern for use as follows: enter first variable on top left scale, move right to the second variable, reflect down at right angles to the third variable, reflect left at right angles to the fourth variable, reflect

down, etc. until the final variable is read out at the final scale. In addition to the primary use, other uses of each chart are explained in the text accompanying each set of performance charts. Colored registration blocks located at the bottom and top of each chart are used to determine if slippage has occurred during printing. If slippage has occurred, refer to chapter 5 for correct operating limits.

NOTE

An example of an auxiliary use of the charts referenced above is as follows: Although the hover chart is primarily arranged to find torque required to hover, by entering torque available as torque required, maximum skid height for hover can also be found. In general, any single variable can be found if all others are known. Also, the tradeoffs between two variables can be found. For example, at a given density altitude and pressure altitude, you can find the maximum gross weight capability as free air temperature changes.

The primary advantage of the helicopter over other aircraft is the capability to hover and takeoff and land vertically (zero air speed flight). To more rapidly calculate the performance trade-offs in hover mode, a Hover Ceiling Chart has been included.

7.6. Data Basis.

The type of data used is indicated at the bottom of each performance chart under DATA BASIS. The applicable report and date of the data are also given. The data provided generally is based on one of four categories:

a. *Flight Test Data.* Data obtained by flight test of the aircraft by experienced flight test personnel at precise conditions using sensitive calibrated instruments.

b. *Derived From Flight Test.* Flight test data obtained on a similar rather than the same aircraft and series. Generally small corrections will have been made.

c. *Calculated Data.* Data based on tests, but not on flight test of the complete aircraft.

d. Estimated Data. Data based on estimates using aerodynamic theory or other means but not verified by flight test.

7-7. Specific Conditions.

The data presented are accurate only for specific conditions listed under the title of each chart. Variables for which data are not presented, but which may affect that phase of performance, are discussed in the text. Where data are available or reasonable estimates can be made, the amount that each variable affects performance will be given.

7-8. General Conditions.

In addition to the specific conditions, the following general conditions are applicable to the performance data.

a. Rigging. All airframe and engine controls are assumed to be rigged within allowable tolerances.

b. Pilot Technique. Normal pilot technique is assumed. Control movements should be smooth and continuous.

c. Aircraft Variation. Variations in performance between individual aircraft are known to exist; however, they are considered to be small and cannot be individually accounted for.

d. Instrument Variation. The data shown in the performance charts do not account for instrument inaccuracies or malfunctions.

7-9. Performance Discrepancies.

Regular use of this chapter will allow you to monitor instruments and other aircraft systems for malfunction, by comparing actual performance with planned performance. Knowledge will also be gained concerning the effects of variables for which data are not provided, thereby increasing the accuracy of performance predictions.

7-10. Definitions of Abbreviations.

a. Unless otherwise indicated in the following list of abbreviations, abbreviations and symbols used in this manual conform to those established in Military Standard MIL-STD-12, which is periodically revised to reflect current changes in abbreviations usage. Accordingly, it may be noted that certain previously established definitions have been replaced by more current abbreviations and symbols.

b. Capitalization and punctuation of abbreviations varies, depending upon the context in which they are used. In general, lower case abbreviations are used in text material, whereas abbreviations used in charts and illustrations appear in full capital letters. Periods do not usually follow abbreviations; however, periods are used with abbreviations that could be mistaken for whole words if the period were omitted.

c. The following list provides definitions for abbreviations used in this manual. The same abbreviation applies for either singular or plural applications.

LIST OF ABBREVIATIONS

Abbreviation	Definition	Abbreviation	Definition
AGL	Above ground level	FT	Foot
ALT	Altitude	FT/MIN	Feet per minute
AVAIL	Available	FWD	Forward
C	Celsius	ΔF	Increment of equivalent flat plate drag area
CAS	Calibrated airspeed	GAL	Gallon
CL	Centerline	GAL/HR	Gallons per hour
CONFIG	Configuration	GW	Gross weight
CONT	Continuous	HP	Horsepower
END	Endurance	HR	Hour
F	Fahrenheit	IAS	Indicated airspeed
FAT	Free air temperature	IGE	In ground effect
FLT	Flight		

LIST OF ABBREVIATIONS (Cont)

Abbreviation	Definition	Abbreviation	Definition
IN	Inch	%Q	Percent torque
IN HG	Inches of mercury	PRESS	Pressure
IR	Infrared	R/C	Rate of climb
KIAS	Knots indicated airspeed	R/D	Rate of descent
KN	Knot	RPM	Revolutions per minute
"	Degree	SPEC	Specifications
OGE	Out of ground effect	STA	Station
LB	Pound	SQ FT	Square feet
LB/HR	Pounds per hour	TAS	True airspeed
LIM	Limit	TOT	Turbine outlet temperature
MAX	Maximum	TRQ	Torque
MIN	Minute	USAASTA	United States Army Aviation
MIN	Minimum		Systems Test Activity
MM	Millimeter	VDC	Volts, direct current
N ₂	Power turbine speed	V _{NE}	Velocity, never exceed
NO	Number		(airspeed limitation)
NM	Nautical Mile	XMSN	Transmission

Section II. TEMPERATURE COVERSION

7-11. Free Air Temperatures.

Obtain the local free air temperature and record in space provided under departure heading. Estimate FAT for climb, cruise, and arrival by subtracting 2 degrees C for each 1000 feet altitude increase above departure point; (if destination is below departure elevation, add 2°C for each 1000

difference in elevation). Record temperatures in spaces provided under climb, cruise and arrival headings. Refer to fig. 7-2.

7-12. Deleted.

7-13. Deleted.

All data on pages 7-6 thru 7-7/7-8, including fig. 7-1, is deleted.

TEMPERATURE CONVERSION

TEMPERATURE
CONVERSION
OH-58C
T63-A-720

EXAMPLE

WANTED

FREE AIR TEMPERATURE IN DEGREES CELSIUS

KNOWN

FREE AIR TEMPERATURE = $+32^{\circ}\text{F}$

METHOD

ENTER FREE AIR TEMPERATURE
HERE
MOVE RIGHT TO DIAGONAL LINE
MOVE DOWN TO DEGREES CELSIUS SCALE
READ FREE AIR TEMPERATURE = 0°C

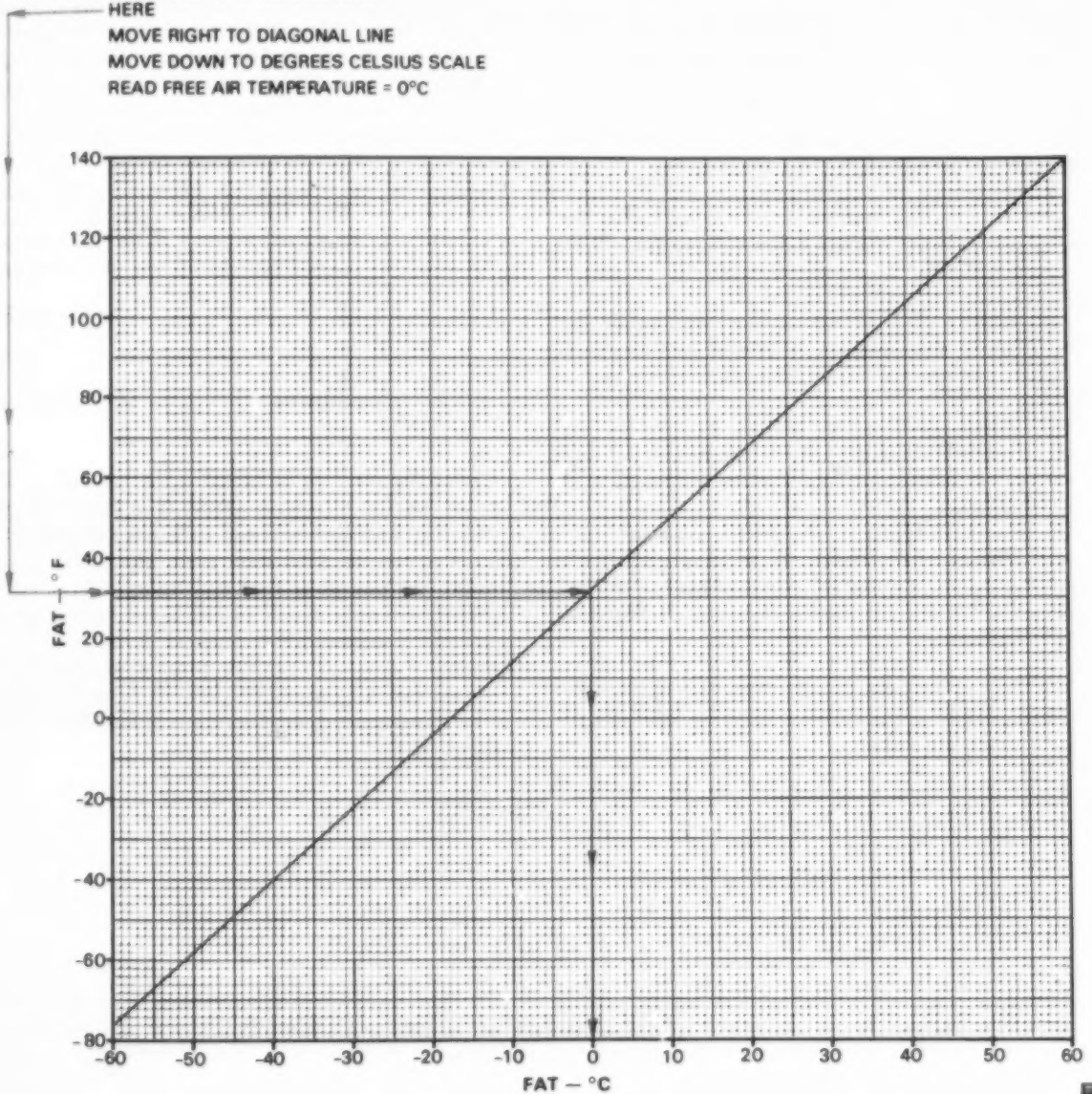


Figure 7-2. Temperature conversion chart

Section III. TORQUE AVAILABLE

7-14. Description.

The torque available charts show the effects of altitude and temperature on engine torque.

7-15. Chart Differences.

Both pressure altitude and FAT affect engine power production. Figures 7-3 and 7-4 show power available data at 30 minute power and maximum continuous power ratings in terms of the allowable torque as recorded by the torquemeter (%Q).

Note that the power output capability of the T63-A-720 engine can exceed the transmission structural limit (100 %Q) under certain conditions.

a. Figure 7-3 (sheet 1) is applicable for maximum power, engine deice and heater off, 30 minute operation at 100% N2 rpm.

b. Figure 7-3 (sheet 2) is applicable for maximum power, engine deice and heater on, 30 minute operation at 100% N2 rpm.

c. Figure 7-3 (sheet 3) is applicable for maximum power, engine deice and heater off and reverse flow inlet installed, 30 minute operation at 100% N2 rpm.

d. Figure 7-3 (sheet 4) is applicable for maximum power, engine deice and heater on and reserve flow inlet installed, 30 minute operation at 100% N2 rpm.

e. Figure 7-4 (sheets 1 through 4) is applicable for maximum continuous power for the above mentioned conditions.

f. Prolonged IGE hover may increase engine inlet temperature as much as 10°C, therefore, a higher FAT must be used to correct for the increase under this condition.

7-16. Use of Charts.

The primary use of the charts is illustrated by the examples. In general, to determine the maximum power available, it is necessary to know the pressure altitude and temperature. By entering the upper left side of the chart at the known pressure altitude, moving right to the known temperature, then straight down to the bottom of the lower grid, available torque is obtained. If the CONT XMSN LIM line is intersected prior to reaching the temperature line, TORQUE AVAILABLE is 85%. Operations in the yellow area of the chart (between 85 and 100%) are limited to 5 minutes duration.

7-17. Conditions.

Chart (figure 7-3) is based upon speeds @ 100% rotor/engine rpm with grade JP-4 fuel. The use of aviation gasoline will not influence engine power. Fuel grade of JP-5 will yield the same nautical miles per pound of fuel and being 6.8 pounds per gallon will only result in increased fuel weight per gallon. Because JP-4 and JP-5 have the same energy value per pound, then JP-5 fuel will increase range by almost 5 percent per gallon of fuel. The 30 minutes operation limit is based on TOT indication.

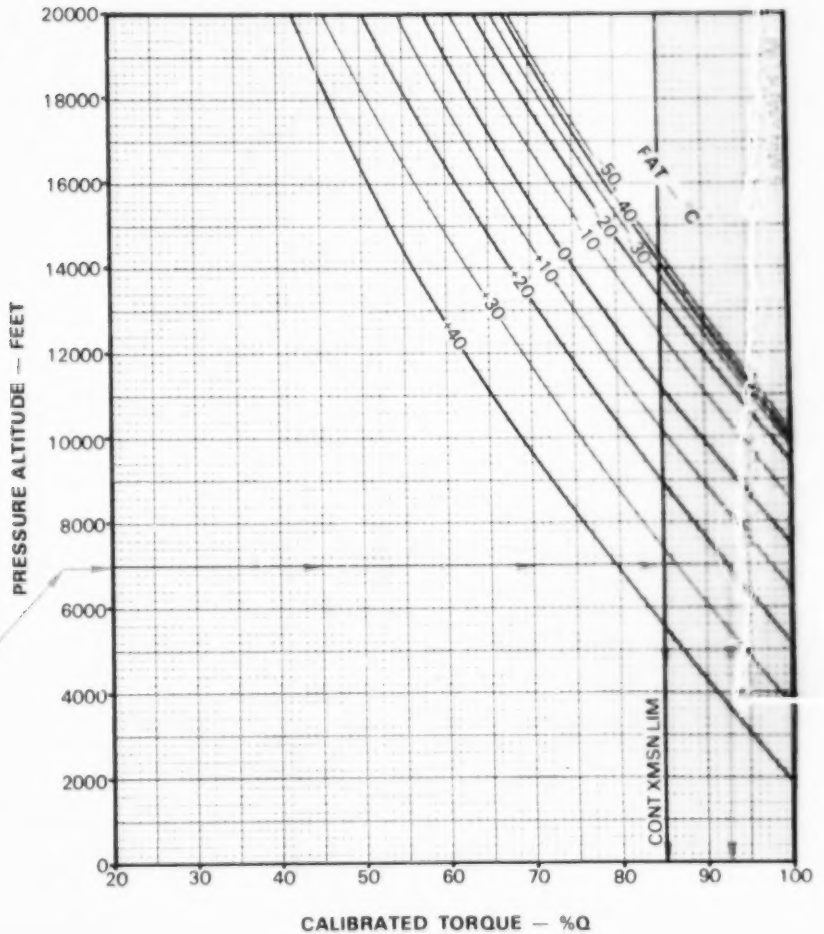
MAXIMUM TORQUE AVAILABLE (30 MINUTE OPERATION) **ENGINE DEICE AND HEATER OFF** **100% RPM, JP-4 FUEL**

**MAXIMUM
TORQUE**
OH 58C
T63 A 720

EXAMPLE
WANTED
 CALIBRATED TORQUE

KNOWN
 PRESSURE ALTITUDE = 7000 FEET
 FAT = 20°C

METHOD
 ENTER PRESSURE ALTITUDE HERE
 MOVE RIGHT TO FAT
 MOVE DOWN TO, READ
 CALIBRATED TORQUE = 92.5%Q (5 MIN)
 CALIBRATED TORQUE = 85%Q (30 MIN)



DATA BASIS: CALCULATED FROM MODEL SPEC 876, 25 JULY 1975.
 CORRECTED FOR INSTALLATION LOSSES BASED ON FLIGHT TEST OF SIMILAR TYPE AIRCRAFT



Figure 7-3. Maximum torque available (30 minute operation) chart (Sheet 1 of 4)

MAXIMUM TORQUE AVAILABLE (30 MINUTE OPERATION)
ENGINE DEICE AND HEATER ON
100% RPM, JP-4 FUEL

**MAXIMUM
TORQUE
OH-58C
T63-A-720**

EXAMPLE

WANTED

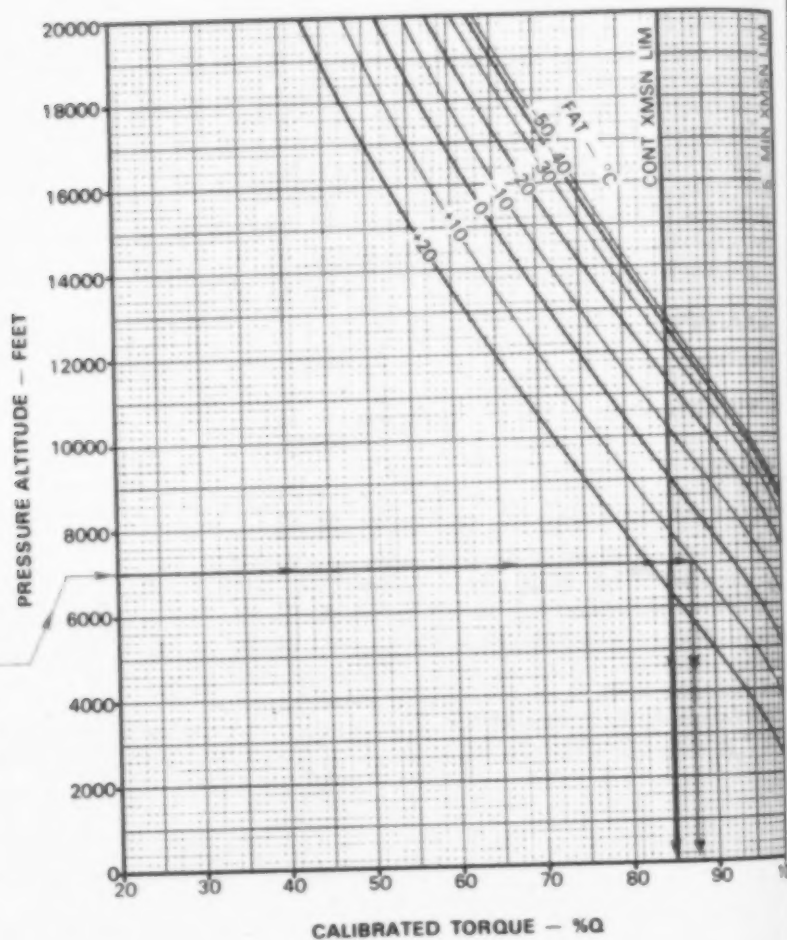
CALIBRATED TORQUE

KNOWN

PRESSURE ALTITUDE = 7000 FEET
 FAT = 10°C

METHOD

ENTER PRESSURE ALTITUDE HERE
 MOVE RIGHT TO FAT
 MOVE DOWN, READ
 CALIBRATED TORQUE = 87.7%Q (5 MIN)
 CALIBRATED TORQUE = 85.0%Q (30 MIN)



DATA BASIS: CALCULATED FROM MODEL SPEC 876, 25 JULY 1975.
 CORRECTED FOR INSTALLATION LOSSES BASED ON FLIGHT TEST OF SIMILAR TYPE AIRCRAFT

Figure 7-3. Maximum torque available (30 minute operation) chart (Sheet 2 of 4)

MAXIMUM TORQUE AVAILABLE (30 MINUTE OPERATION)
ENGINE DEICE AND HEATER OFF AND REVERSE FLOW INLET INSTALLED
100% RPM, JP-4 FUEL

**MAXIMUM
TORQUE
OH-58C
T63-A-720**

EXAMPLE

WANTED

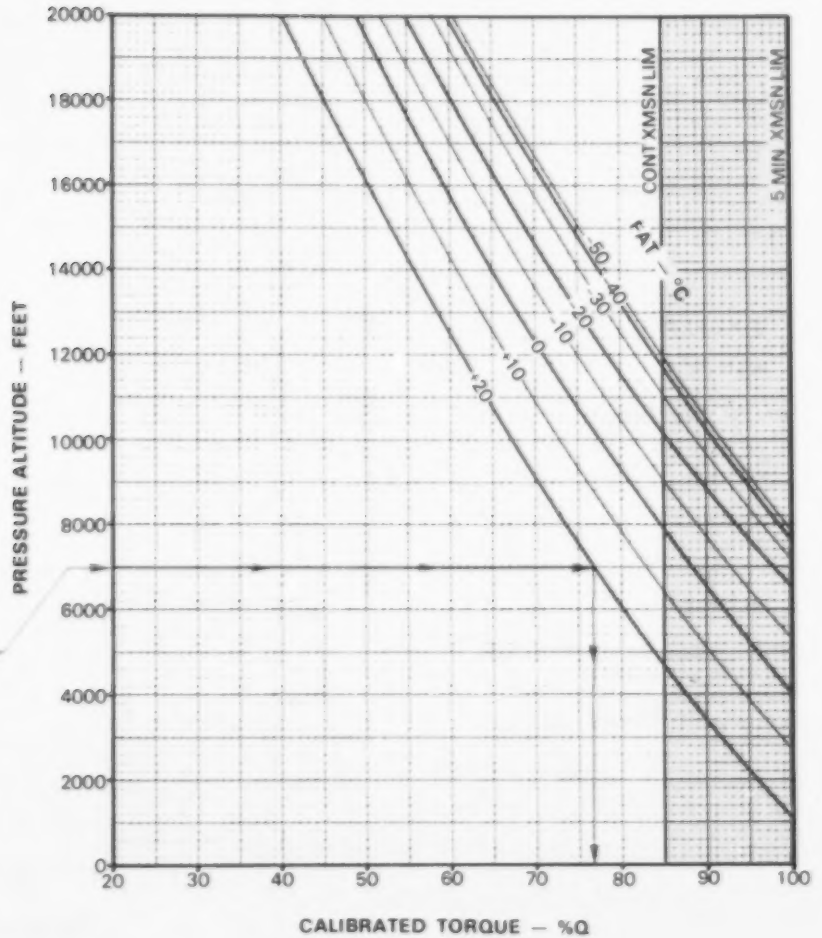
CALIBRATED TORQUE

KNOWN

PRESSURE ALTITUDE = 7000 FEET
 FAT = 20°C

METHOD

ENTER PRESSURE ALTITUDE HERE
 MOVE RIGHT TO FAT
 MOVE DOWN, READ
 CALIBRATED TORQUE = 76.8%Q



DATA BASIS: CALCULATED FROM MODEL SPEC 876, 25 JULY 1975.
 CORRECTED FOR INSTALLATION LOSSES BASED ON FLIGHT TEST OF SIMILAR TYPE AIRCRAFT



Figure 7-3. Maximum torque available (30 minute operation) chart (Sheet 3 of 4)

☒ **MAXIMUM TORQUE AVAILABLE (30 MINUTE OPERATION)**
☒ **ENGINE DEICE AND HEATER ON AND REVERSE FLOW INLET INSTALLED**
 100% RPM, JP-4 FUEL

**MAXIMUM
TORQUE**
OH-58C
T63-A 720

EXAMPLE

WANTED

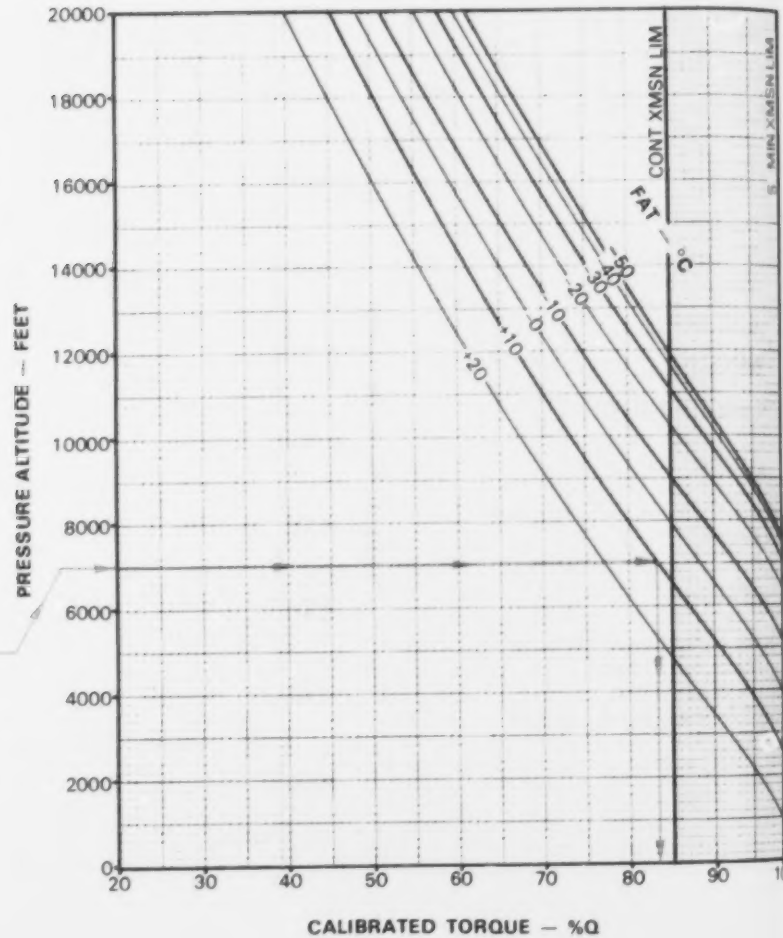
CALIBRATED TORQUE

KNOWN

PRESSURE ALTITUDE = 7000 FEET
 FAT = 10°C

METHOD

ENTER PRESSURE ALTITUDE HERE →
 MOVE RIGHT TO FAT
 MOVE DOWN, READ
 CALIBRATED TORQUE : 83.5%Q



DATA BASIS: CALCULATED FROM MODEL SPEC 876, 25 JULY 1975,
 CORRECTED FOR INSTALLATION LOSSES BASED ON FLIGHT TEST OF SIMILAR TYPE AIRCRAFT

Figure 7-3. Maximum torque available (30 minute operation) chart (Sheet 4 of 4)

TORQUE AVAILABLE — CONTINUOUS OPERATION**ENGINE DEICE AND HEATER OFF****100% RPM, JP-4 FUEL**

TORQUE AVAILABLE
OH-58C
T63-A-720

EXAMPLE**WANTED**

CALIBRATED TORQUE

KNOWN

PRESSURE ALTITUDE = 7000 FEET

FAT = 20°C

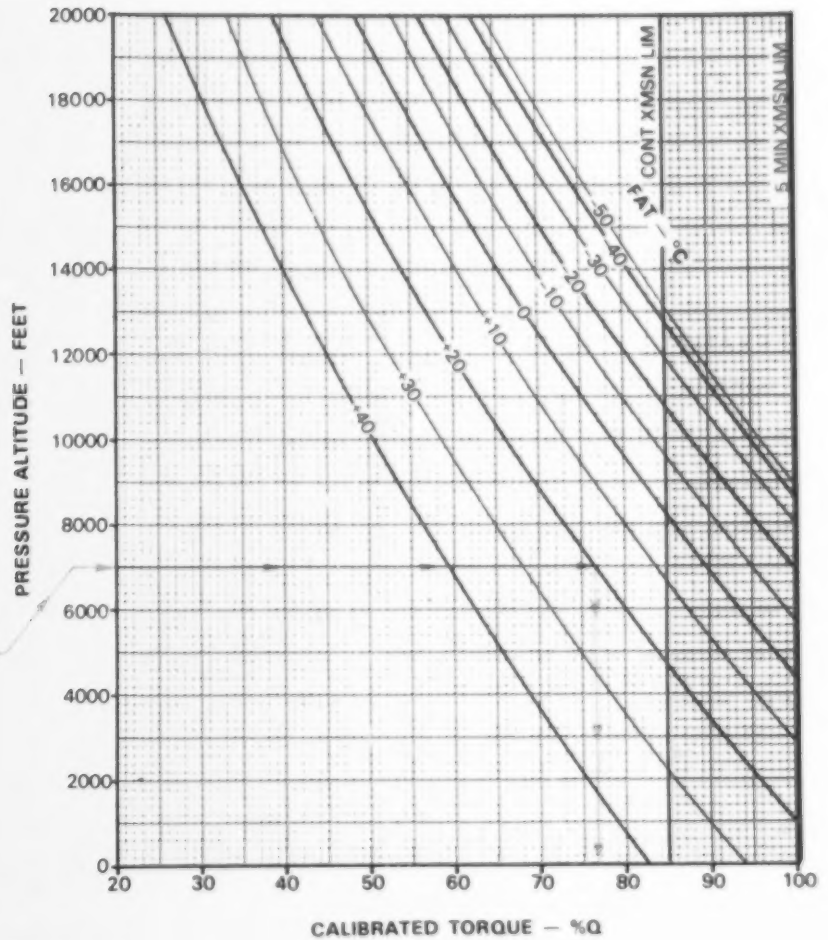
METHOD

ENTER PRESSURE ALTITUDE HERE

MOVE RIGHT TO FAT

MOVE DOWN, READ

CALIBRATED TORQUE = 76.5 %Q



DATA BASIS: CALCULATED FROM MODEL SPEC 876, 25 JULY 1975.
CORRECTED FOR INSTALLATION LOSSES BASED ON FLIGHT TEST OF SIMILAR TYPE AIRCRAFT

Figure 7-4. Torque available (continuous operation) chart (Sheet 1 of 4)



TORQUE AVAILABLE — CONTINUOUS OPERATION **ENGINE DEICE AND HEATER ON** **100% RPM, JP-4 FUEL**

**TORQUE
AVAILABLE
OH-58C
T63-A-720**

EXAMPLE

WANTED

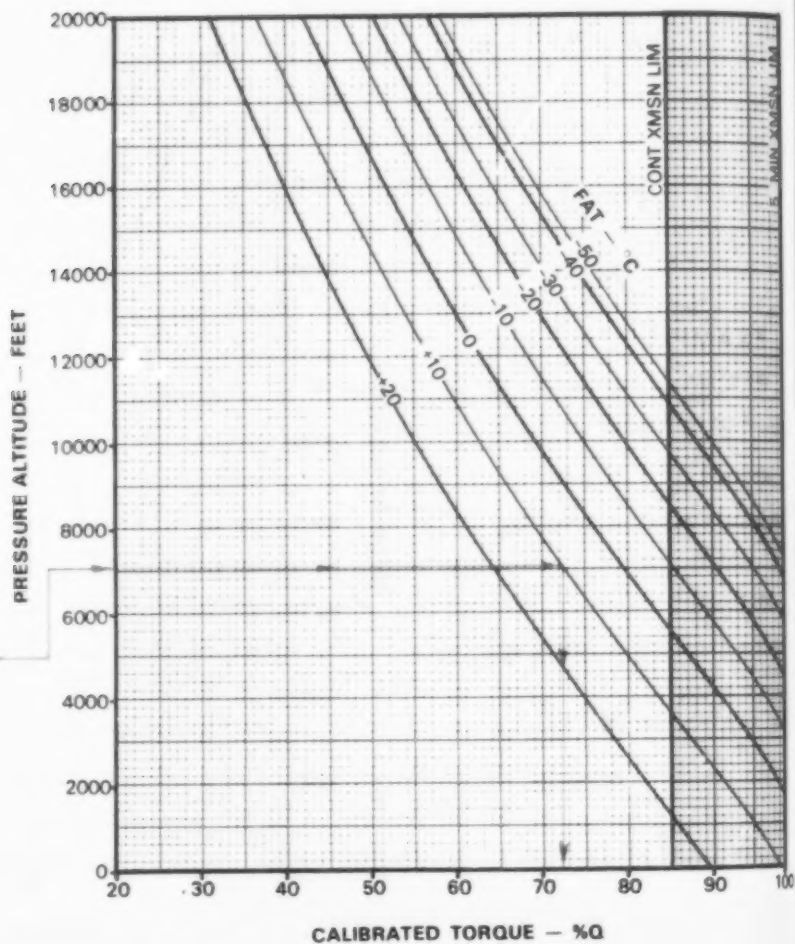
CALIBRATED TORQUE

KNOWN

PRESSURE ALTITUDE = 7000 FEET
 FAT = 10°C

METHOD

ENTER PRESSURE ALTITUDE HERE →
 MOVE RIGHT TO FAT
 MOVE DOWN, READ
 CALIBRATED TORQUE = 72.5 %Q



DATA BASIS: CALCULATED FROM MODEL SPEC 876, 25 JULY 1975.
 CORRECTED FOR INSTALLATION LOSSES BASED ON FLIGHT TEST OF SIMILAR TYPE AIRCRAFT

Figure 7-4. Torque available (continuous operation) chart (Sheet 2 of 4)

TORQUE AVAILABLE — CONTINUOUS OPERATION

ENGINE DEICE AND HEATER OFF AND REVERSE FLOW INLET INSTALLED
100% RPM, JP-4 FUEL

TORQUE AVAILABLE
OH-58C
T63-A-720



EXAMPLE

WANTED

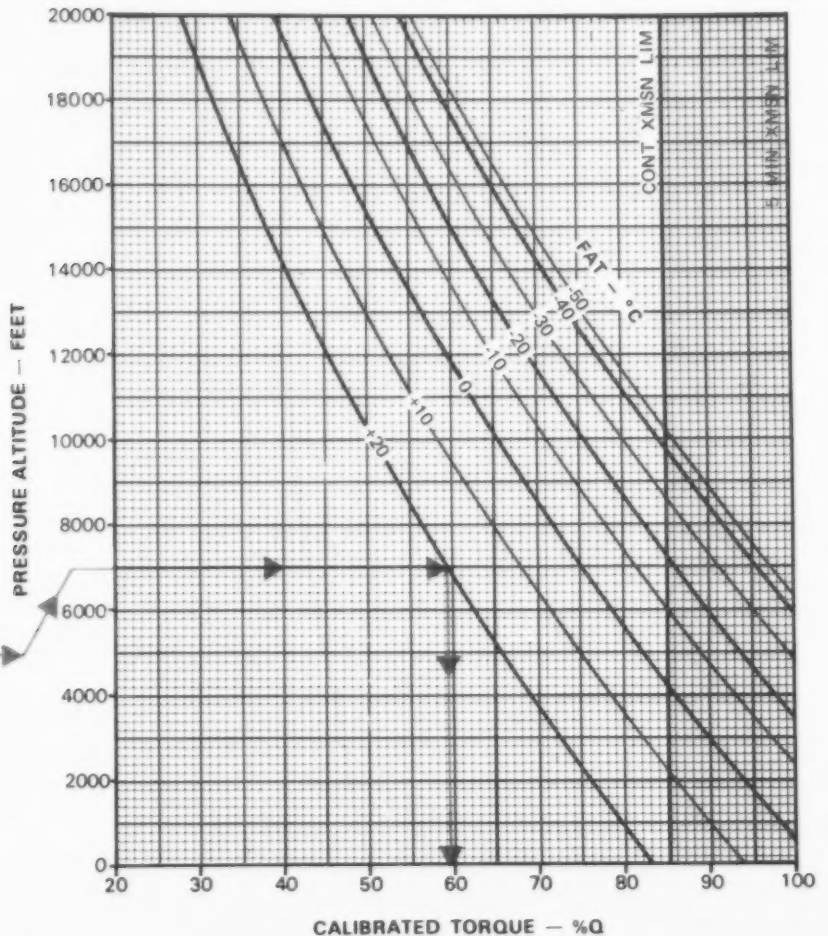
CALIBRATED TORQUE

KNOWN

PRESSURE ALTITUDE = 7000 FEET
FAT = 20°C

METHOD

ENTER PRESSURE ALTITUDE HERE
MOVE RIGHT TO FAT
MOVE DOWN, READ
CALIBRATED TORQUE = 59.5 %Q



DATA BASIS: CALCULATED FROM MODEL SPEC 876, 25 JULY 1975.
CORRECTED FOR INSTALLATION LOSSES BASED ON FLIGHT TEST OF SIMILAR TYPE AIRCRAFT

Figure 7-4. Torque available (continuous operation) chart (Sheet 3 of 4)

Change 15

7-17/(7-18 blank)

TORQUE AVAILABLE — CONTINUOUS OPERATION

BLEED AIR ON PARTICLE SEPARATOR AND
REVERSE FLOW INLET INSTALLED
100% RPM JP-4

TORQUE
AVAILABLE
OH-58C
T63-A-720



EXAMPLE

WANTED

CALIBRATED TORQUE

KNOWN

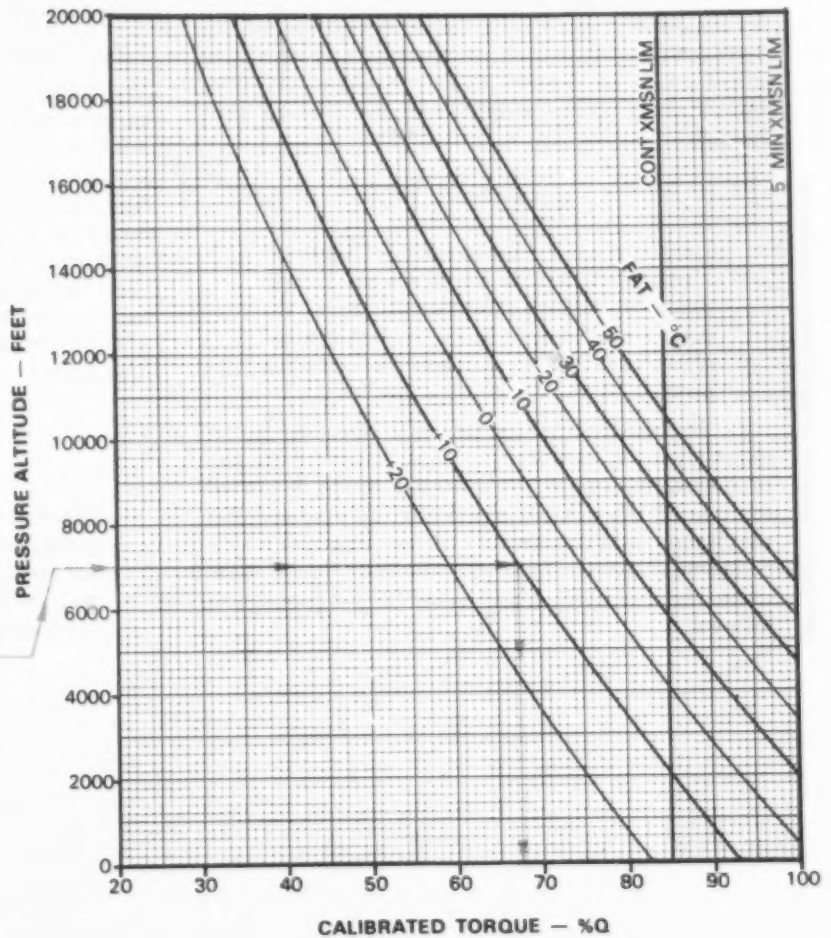
PRESSURE ALTITUDE = 7000 FEET
FAT = 10°C

METHOD

ENTER PRESSURE ALTITUDE HERE

MOVE DOWN, READ

CALIBRATED TORQUE = 67.5 %Q



DATA BASIS: CALCULATED FROM MODEL SPEC 876, 25 JULY 1975.
CORRECTED FOR INSTALLATION LOSSES BASED ON FLIGHT TEST OF SIMILAR TYPE AIRCRAFT

Figure 7-4. Torque available (continuous operation) chart (Sheet 4 of 4)

Section IV. HOVER

7-18. Description.

The hover charts (figure 7-5, sheets 1 and 2) show the hover ceiling and the torque required to hover respectively at various pressure altitudes, ambient temperatures, gross weights, and skid heights. Maximum skid height for hover can also be obtained by using the torque available from figure 7-3.

7-19. Use of Chart.

a. The primary use of the charts is illustrated by the charts examples. In general, to determine to hover ceiling or the torque required to hover, it is necessary to know the pressure altitude, temperature, gross weight and the desired skid height.

CAUTION

Low airspeed maneuvering flights at airspeeds below 35 knots are not recommended under conditions where the power required to hover out of ground effect exceeds the maximum continuous power.

b. In addition to its primary use, the hover chart (sheet 2) can also be used to determine the predicted maximum hover height, which is needed for use of the takeoff chart (figure 7-6); and the maximum right crosswind corresponding to a 10% directional control margin. To determine maximum right crosswind and hover height proceed as follows:

(1) Enter chart at appropriate pressure altitude.

(2) Move right to FAT.

(3) Move down to gross weight, read the maximum right crosswind corresponding to a 10% directional control margin.

(4) Move left to intersection with maximum power available (obtained from figure 7-3).

(5) Read the predicted maximum skid height. This height is the maximum hover height.

7-20. Conditions.

The hover charts are based upon calm wind conditions, a level ground surface, and the use of 100% N2 rpm. Controllability during downwind hovering, crosswinds, sideward flight and rearward flight may be inadequate; however, for stabilized hover in steady winds from the right (i.e., right crosswind) the wind velocities on the chart correspond to the maximum one can have and yet maintain a 10% directional control margin. See Chapter 5 for hovering and low altitude/low airspeed flight limitations.

WARNING

Figure 7-5 (sheet 2 of 2) shows 10% directional control margins only for the stabilized conditions set forth. It does not and is not meant to infer that for corresponding dynamic flight maneuvering conditions such margins exist.

HOVER CEILING **MAXIMUM TORQUE AVAILABLE (30 MINUTE OPERATION)** **100% RPM**

HOVER
OH-58C
T63-A-720

EXAMPLE

WANTED

GROSS WEIGHT TO HOVER OGE (50 FT)

KNOWN

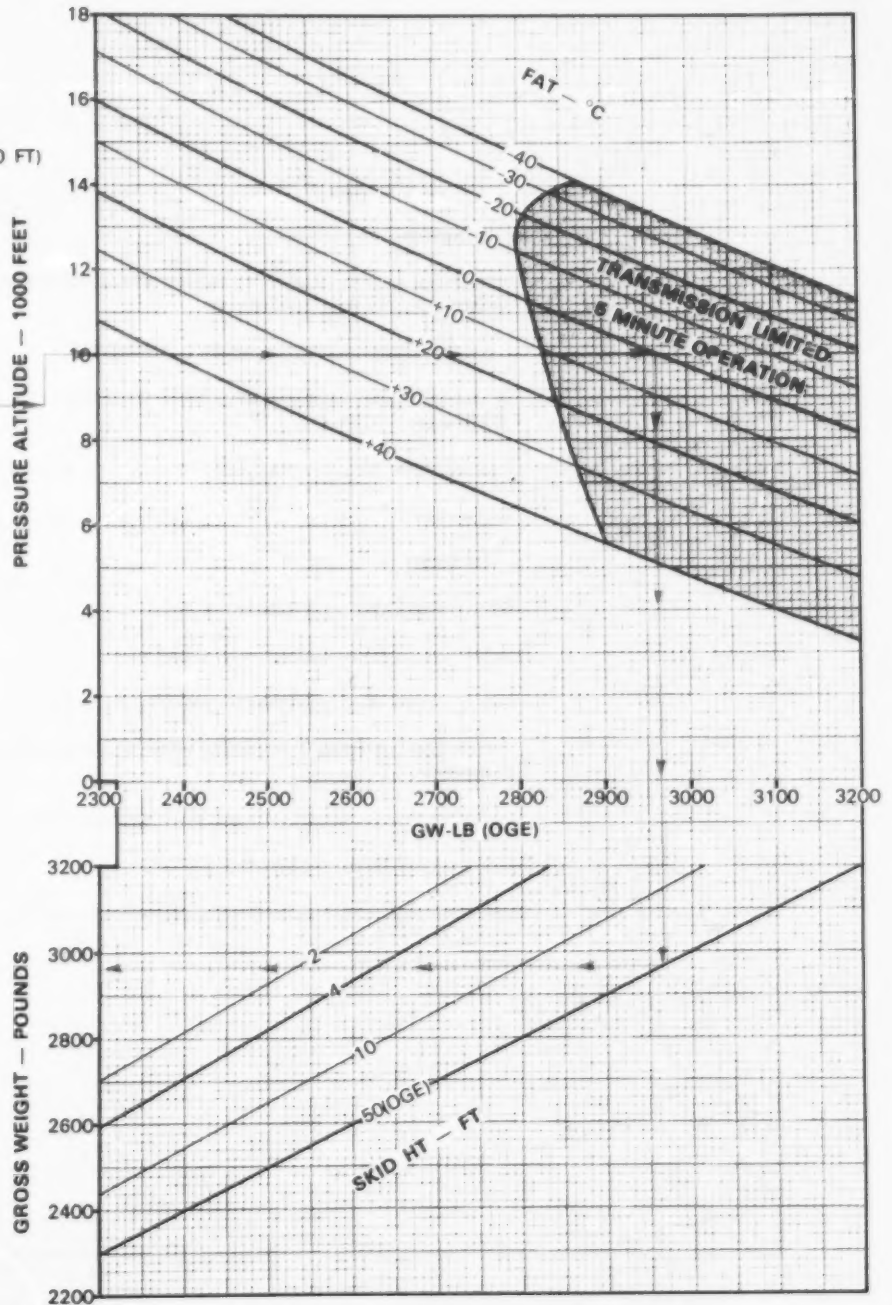
PRESSURE ALTITUDE = 10000 FEET

FAT = 0°C

SKID HEIGHT = OGE (50 FT)

METHOD

ENTER PRESSURE ALTITUDE HERE
 MOVE RIGHT TO FAT
 MOVE DOWN TO SKID HEIGHT
 MOVE LEFT, READ GROSS WEIGHT
 TO HOVER = 2965 POUNDS



DATA BASIS: DERIVED FROM FLIGHT TEST, USAAEFA 74-48, APRIL 1975

Figure 7-5. Hover chart (Sheet 1 of 2)



EXAMPLE

WANTED

MAXIMUM GROSS WEIGHT TO HOVER AT OGE (50 FEET) WITH
REVERSE FLOW INLET INSTALLED.

KNOWN (REFERENCE FIGURE 7-3 SHEET 3)

30 MINUTE TORQUE AVAILABLE WITH REVERSE FLOW INLET
INSTALLED = 76.8% Q

PRESSURE ALTITUDE = 7000 FEET

FAT = +20°C

METHOD

ENTER PRESSURE ALTITUDE HERE

MOVE RIGHT TO INTERSECT +20°C FAT LINE

MOVE DOWN TO DENSITY ALTITUDE OF 8700 FEET

ENTER TORQUE HERE FOR ENGINE WITH REVERSE FLOW INLET
CONDITION

MOVE UP TO INTERSECT OGE (50 FEET) SKID HEIGHT LINE

MOVE RIGHT TO INTERSECT THE VERTICAL

LINE FROM 1 AND READ GROSS WEIGHT TO HOVER = 2760
POUNDS

HOVER **AT 100% N2 RPM** **ALL CONFIGURATIONS LEVEL SURFACE CALM WIND**

HOVER
OH-58C
T63-A-720

EXAMPLE

WANTED

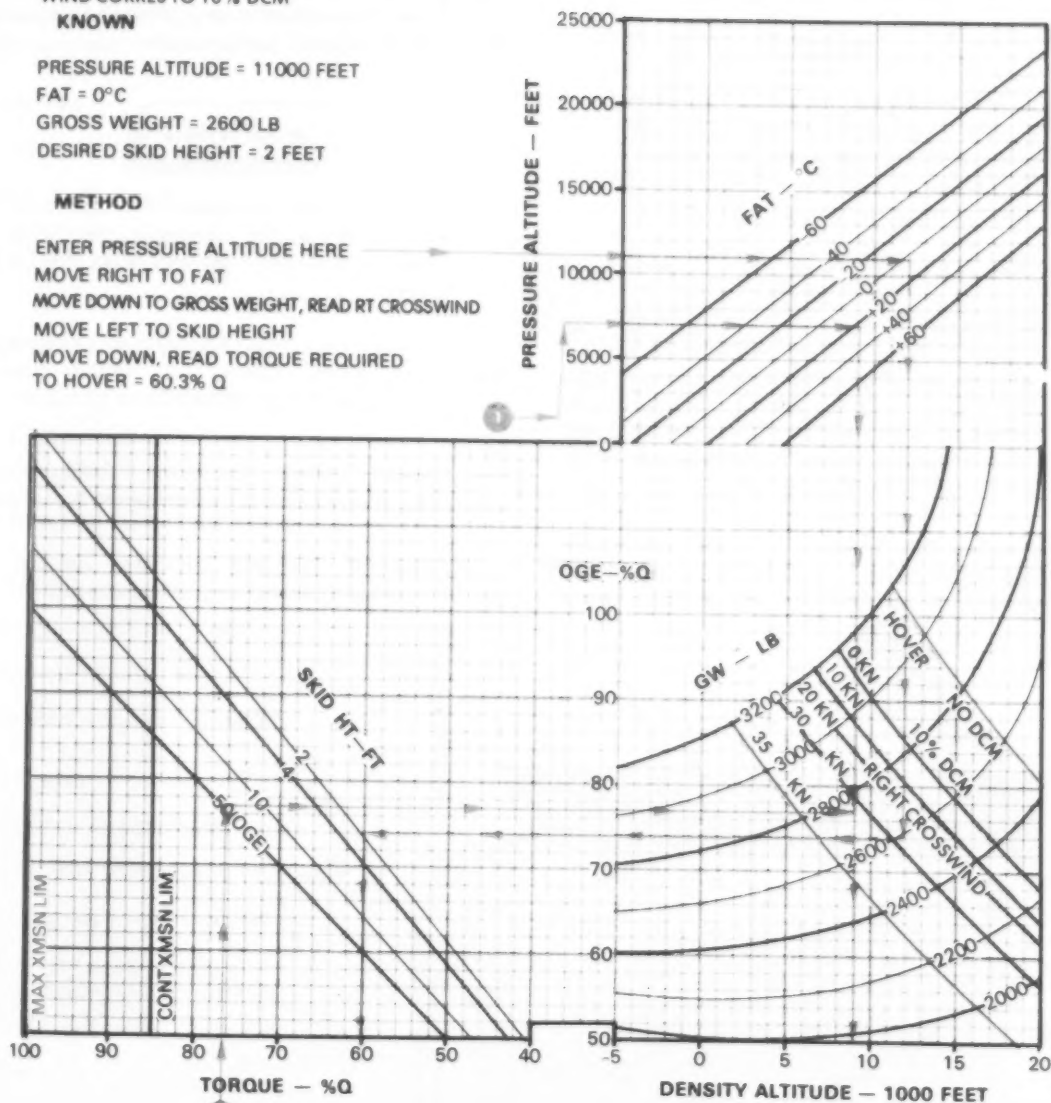
TORQUE REQUIRED TO HOVER & RT CROSS-
WIND CORRES TO 10% DCM

KNOWN

PRESSURE ALTITUDE = 11000 FEET
FAT = 0°C
GROSS WEIGHT = 2600 LB
DESIRED SKID HEIGHT = 2 FEET

METHOD

ENTER PRESSURE ALTITUDE HERE
MOVE RIGHT TO FAT
MOVE DOWN TO GROSS WEIGHT, READ RT CROSSWIND
MOVE LEFT TO SKID HEIGHT
MOVE DOWN, READ TORQUE REQUIRED
TO HOVER = 60.3% Q



DATA BASIS: DERIVED FROM FLIGHT TEST, USAAEFA 74-48, APRIL 1975

Figure 7-5. Hover chart (Sheet 2 of 2)

Section V. TAKEOFF

7-21. Description.

The takeoff chart (figure 7-6) shows the distances to clear various obstacle heights, based upon a level acceleration technique. Takeoff distance is shown as a function of several hover height capabilities. The upper chart grid presents data for climbout at a constant 35 knots INDICATED airspeed. The two lower grids present data for climbouts at various TRUE airspeeds.

NOTE

The hover heights shown on the chart are only a measure of the helicopters climb capability and do not imply that a higher than normal hover height should be used during the actual takeoff.

7-22. Use of Chart.

The primary use of this chart is illustrated by the chart example. The main consideration for takeoff performance is the hovering skid height capability, which includes the effects of pressure altitude, free air temperature, gross weight, and torque. Hover height capability is determined by use of the hover chart, figure 7-5.

A hover check can be made to verify the hover capability. If winds are present, the hover check may disclose that the helicopter can actually hover

at a greater skid height than the calculated value, since the hover chart is based upon calm wind conditions.

7-23. Conditions.

a. Wind. The takeoff chart is based upon calm wind conditions. Since surface wind velocity and direction cannot be accurately predicted, all takeoff planning should be based upon calm wind conditions. Takeoff into any prevailing wind will improve the takeoff performance.

WARNING

A tailwind during takeoff and climbout will increase the obstacle clearance distance and could prevent a successful takeoff.

b. Power Settings. All takeoff performance data are based upon the torque used in determining the hover capabilities in figure 7-5.

c. Hover. Yellow indicates limit hovered capability where takeoff performance is marginal.

d. Takeoff. The red indicates limited compatibility where takeoff should be attempted.

TAKEOFF

LEVEL ACCELERATION TECHNIQUE FROM A 3 FT SKID HEIGHT

100% RPM, MAXIMUM TORQUE AVAILABLE

ALL CONFIGURATIONS CALM WIND

TAKEOFF
OH-58C
T63-A-720

EXAMPLE A

WANTED

DISTANCE TO CLEAR OBSTACLE

KNOWN

MAXIMUM HOVER HEIGHT = 10 FEET

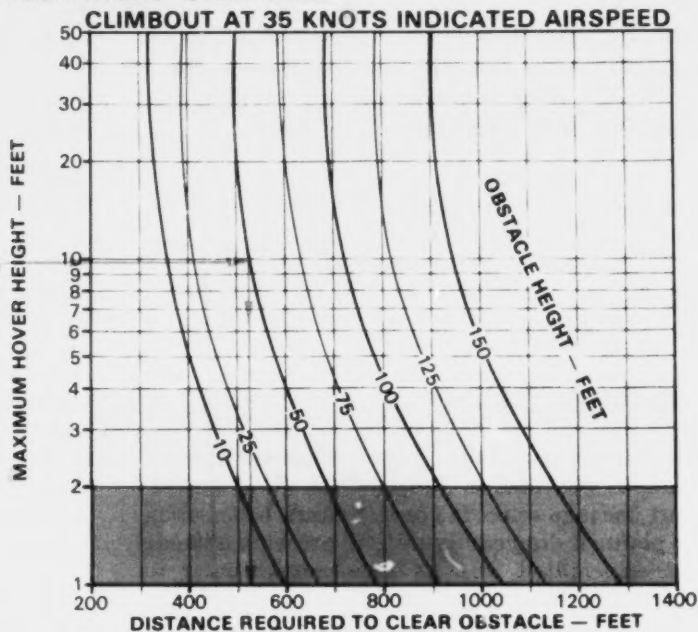
OBSTACLE HEIGHT = 50 FEET

METHOD

ENTER MAX HOVER HEIGHT HERE

MOVE RIGHT TO OBSTACLE HEIGHT

MOVE DOWN, READ DISTANCE
TO CLEAR OBSTACLE = 530 FEET



EXAMPLE B

WANTED

DISTANCE TO CLEAR OBSTACLE

KNOWN

MAX HOVER HEIGHT = 8 FEET

OBSTACLE HEIGHT = 50 FEET

CLIMBOUT AIRSPEED = 40 KNOTS

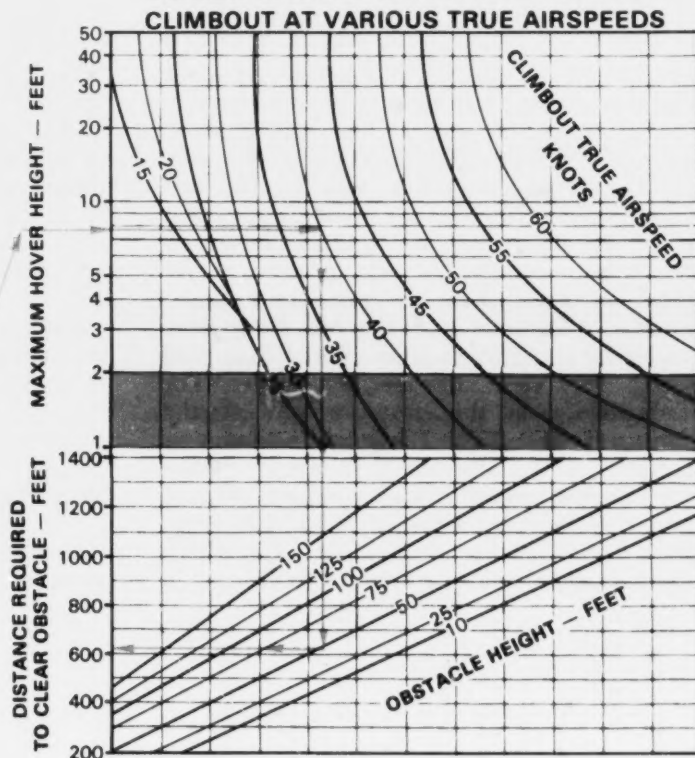
METHOD

ENTER MAX HOVER HEIGHT HERE

MOVE RIGHT TO CLIMBOUT TRUE AIRSPEED

MOVE DOWN TO OBSTACLE HEIGHT

MOVE LEFT READ DISTANCE
TO CLEAR OBSTACLE = 635 FEET



DATA BASIS: DERIVED FROM FLIGHT TEST OF SIMILAR TYPE AIRCRAFT

Figure 7-6. Takeoff chart

Section VI. CRUISE

7-24. Description.

The cruise charts (figure 7-7, sheets 1 through 13) show the torque pressure and engine rpm required for level flight at various pressure altitudes, airspeeds, gross weights and fuel flows.

NOTE

The cruise charts are basically arranged by FAT groupings. Figure 7-7, sheets 1 through 13, are based upon operation with clean configuration.

7-25. Use of Charts.

The primary use of the charts is illustrated by the examples provided in figure 7-7. The first step for chart use is to select the proper chart, based upon the planned drag configuration, pressure altitude and anticipated free air temperature; refer to chapter 7 index (paragraph 7-2). Normally, sufficient accuracy can be obtained by selecting the chart nearest to the planned cruising altitude and FAT, or the next higher altitude and FAT (chart Example A, Method 2). If greater accuracy is required, interpolation between altitudes and/or temperatures will be required (chart Example A, Method 1). You may enter the charts on any side: TAS, IAS, torque pressure, or fuel flow, and then move vertically or horizontally to the gross weight, then to the other three parameters. Maximum performance conditions are determined by entering the chart where the maximum range or maximum endurance and rate of climb lines intersect the appropriate gross weight; then read airspeed, fuel flow and percent torque. For conservatism, use the gross weight at the beginning of cruise flight. For greater accuracy on long flights it is preferable to determine cruise information for several flight segments in order to allow for decreasing fuel weights (reduced gross weight). The following parameters contained in each chart are further explained as follows:

a. *Airspeed.* True and indicated airspeeds are presented at opposite sides of each chart. On any chart, indicated airspeed can be directly converted to true airspeed (or vice versa) by reading directly across the chart without regard for other chart information. Maximum permissible airspeed (V_{NE}) limits appear as red lines on some charts. If no red line appears, V_{NE} is above the limits of the chart.

b. *Torque (%Q).* Since pressure altitude and temperature are fixed for each chart, torque varies according to gross weight and airspeed.

c. *Fuel Flow.* Fuel flow scales are provided opposite the torque scales. On any chart, torque may be converted directly to fuel flow without regard for other chart information. All fuel flow information is presented with particle separator and engine deice and heater off. Fuel flow increases 5% with reverse flow inlets installed.

d. *Maximum Range.* The maximum range lines indicate the combinations of weight and airspeed that will produce the greatest flight range per gallon of fuel under zero wind conditions. When a maximum range condition does not appear on a chart it is because the maximum range speed is beyond the maximum permissible speed (V_{NE}); in such cases, use V_{NE} cruising speed to obtain maximum range.

e. *Maximum Endurance and Maximum Rate of Climb.* The maximum endurance and maximum rate of climb lines indicate the airspeed for minimum torque required to maintain level flight for each gross weight, FAT and pressure altitude. Since minimum torque will provide minimum fuel flow, maximum flight endurance will be obtained at the airspeeds indicated.

7-26. Conditions.

The cruise charts are based upon operation at 100% rpm, engine deice and heater off.

CRUISE

PRESSURE ALTITUDE — SEA LEVEL TO 2000 FEET
CLEAN CONFIGURATION JP-4/JP-5 FUEL OGE

CRUISE
 OH-58C
 T63-A-720

EXAMPLE A**100% RPM****FAT = -30°C****WANTED**

TORQUE REQUIRED FOR LEVEL FLIGHT,
 FUEL FLOW, INDICATED AIRSPEED

KNOWN

CLEAN CONFIGURATION
 GROSS WEIGHT = 2800 LB
 PRESSURE ALTITUDE = 1000 FEET
 FAT = -30°C
 DESIRED TRUE AIRSPEED = 90 KNOTS

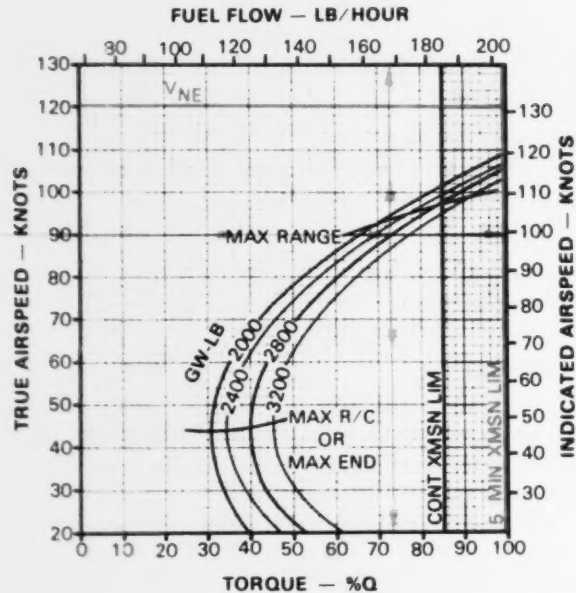
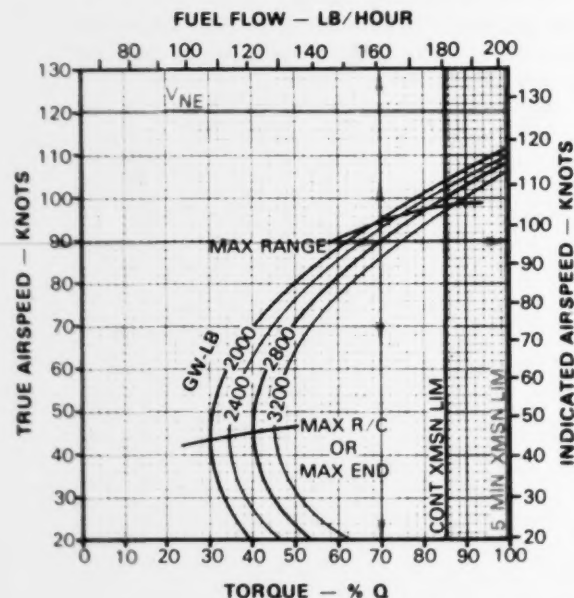
METHOD 1 (INTERPOLATE — MOST ACCURATE)

ENTER TRUE AIRSPEED HERE →
 READ TORQUE, FUEL FLOW, AND IAS ON EACH
 ADJACENT ALTITUDE AND/OR FAT, THEN
 INTERPOLATE BETWEEN ALTITUDE AND FAT

ALTITUDE, FEET	SEA LEVEL	2000 FEET	1000 FEET
FAT, °C	-30	-30	-30
TORQUE, %Q	73	70	71.5
FUEL FLOW, LB/HR	168	161	164.5
IAS, KNOTS	99	96	97.5

METHOD 2 (SIMPLEST)

USE NEXT HIGHEST ALTITUDE AND/OR TEMPERATURE
 (2000 FEET, -30°C)
 ENTER TRUE AIRSPEED HERE →
 MOVE RIGHT TO GROSS WEIGHT
 MOVE DOWN AND READ CALIBRATED TORQUE = 70 %Q
 MOVE UP AND READ FUEL FLOW = 161 LB/HR
 MOVE RIGHT, READ IAS = 96 KNOTS

PRESSURE ALTITUDE — SEA LEVEL**PRESSURE ALTITUDE — 2000 FEET**

DATA BASIS: DERIVED FROM BELL HELICOPTER TEXTRON FLIGHT TEST

Figure 7-7. Cruise chart (Sheet 1 of 13)

CRUISE **PRESSURE ALTITUDE — 4000 FEET TO 6000 FEET** **CLEAN CONFIGURATION JP-4/JP-5 FUEL OGE**

100% RPM

FAT = -30°C

CRUISE
OH-58C
T63-A-720

EXAMPLE B

WANTED

SPEED FOR MAXIMUM RANGE
 TORQUE REQUIRED AND FUEL FLOW AT MAXIMUM RANGE
 SPEED FOR MAXIMUM ENDURANCE

KNOWN

CLEAN CONFIGURATION, FAT = -30°C,
 PRESSURE ALTITUDE = 4000 FEET,
 AND GROSS WEIGHT = 2800 POUNDS

METHOD

LOCATE (-30°C FAT, 4000 FEET) CHART
 FIND INTERSECTION OF 2800 LB GROSS WEIGHT LINE
 WITH THE MAXIMUM RANGE LINE

TO READ SPEED FOR MAXIMUM RANGE:

MOVE LEFT, READ TAS = 98.5 KNOTS AND
 MOVE RIGHT, READ IAS = 101 KNOTS

TO READ FUEL FLOW REQUIRED:

MOVE UP, READ FUEL FLOW = 170 LB/HR

TO READ TORQUE REQUIRED:

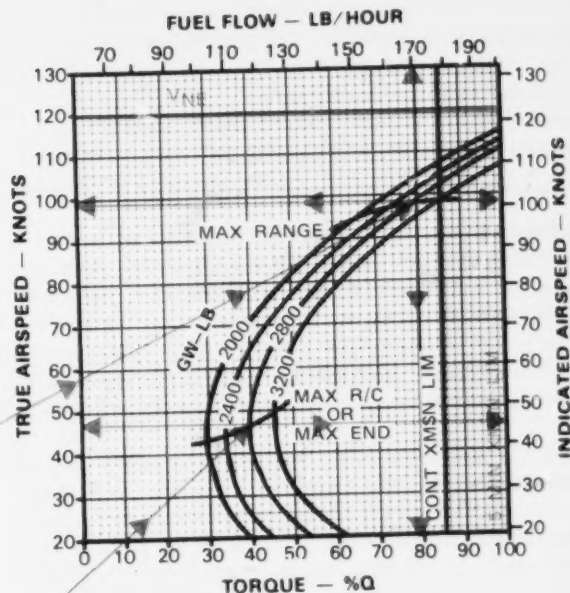
MOVE DOWN, READ TORQUE = 79.5 %Q

FIND INTERSECTION OF 2800 LB GROSS WEIGHT LINE
 WITH THE MAXIMUM ENDURANCE LINE

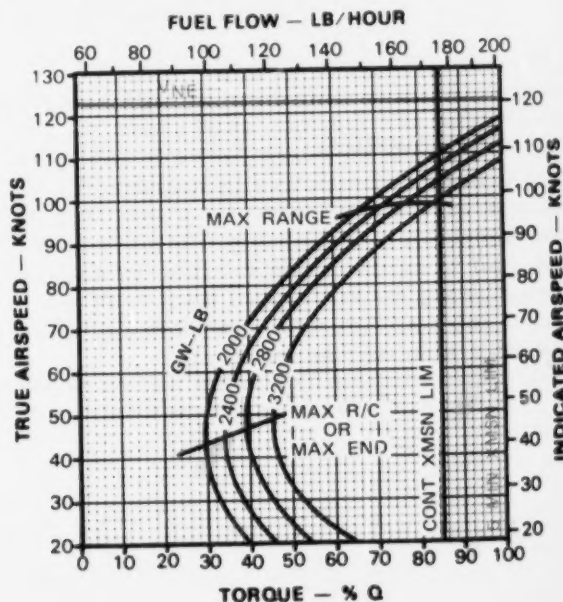
TO READ SPEED FOR MAXIMUM ENDURANCE

MOVE LEFT, READ TAS = 47 KNOTS AND
 MOVE RIGHT, READ IAS = 46 KNOTS

PRESSURE ALTITUDE — 4000 FEET



PRESSURE ALTITUDE — 6000 FEET



DATA BASIS: DERIVED FROM FLIGHT TEST OF SIMILAR TYPE AIRCRAFT

Figure 7-7. Cruise chart (Sheet 2 of 13)

CRUISE

PRESSURE ALTITUDE — 8000 FEET TO 14000 FEET
CLEAN CONFIGURATION JP-4/ JP-5 FUEL OGE

100% RPM

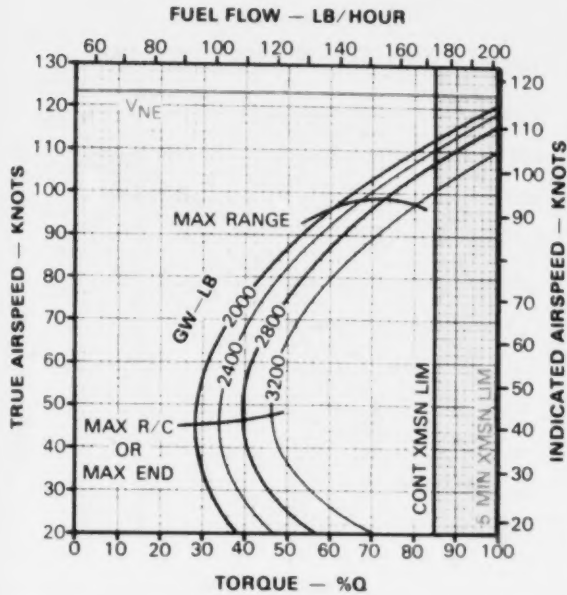
FAT = -30°C

CRUISE

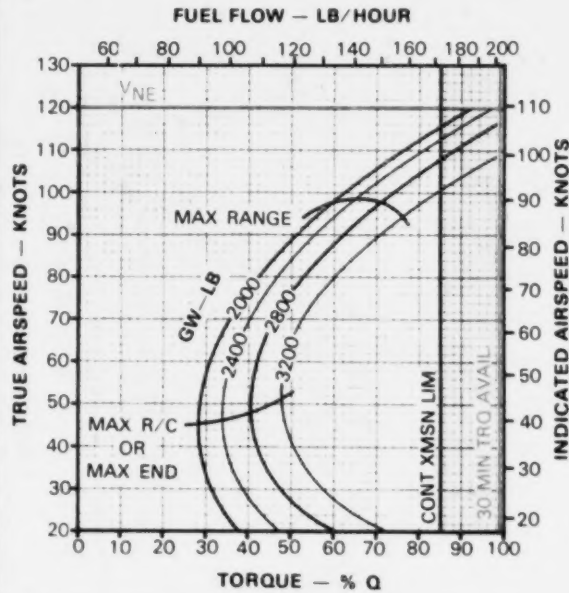
OH-58C

T63-A-720

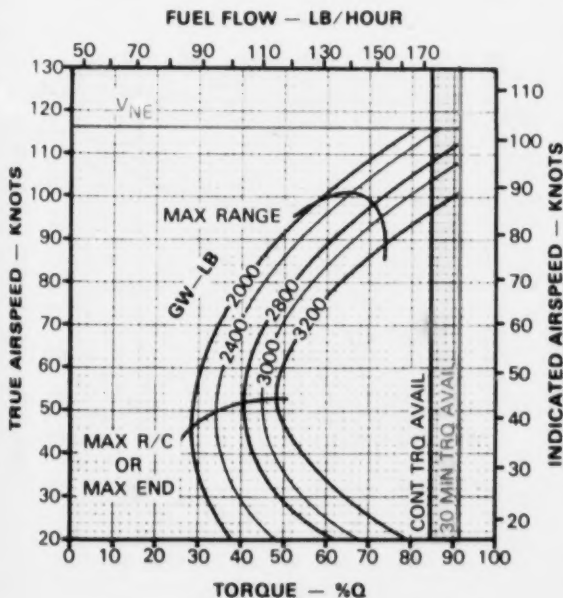
PRESSURE ALTITUDE — 8000 FEET



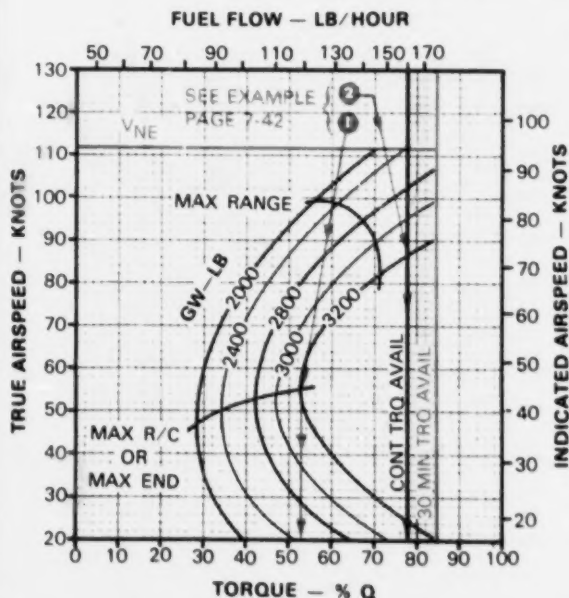
PRESSURE ALTITUDE — 10000 FEET



PRESSURE ALTITUDE — 12000 FEET



PRESSURE ALTITUDE — 14000 FEET



DATA BASIS: DERIVED FROM FLIGHT TEST, ASTA PROJECT NO 68-30, SEPTEMBER 1970

Figure 7-7. Cruise chart (Sheet 3 of 13)

CRUISE

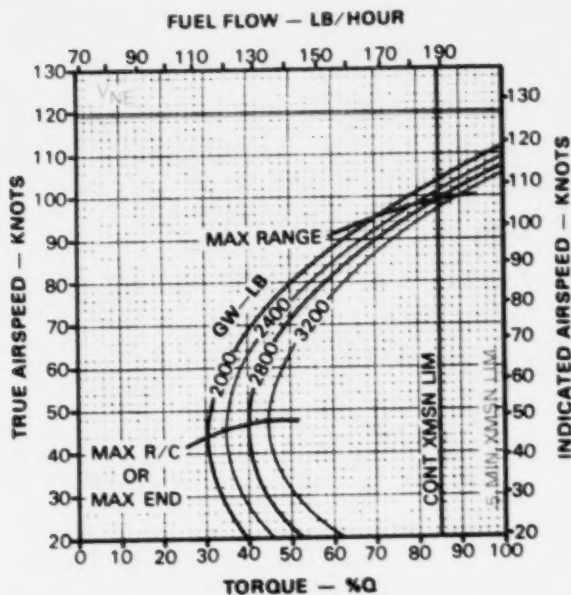
PRESSURE ALTITUDE — SEA LEVEL TO 6000 FEET
CLEAN CONFIGURATION JP-4/JP-5 FUEL OGE

100% RPM

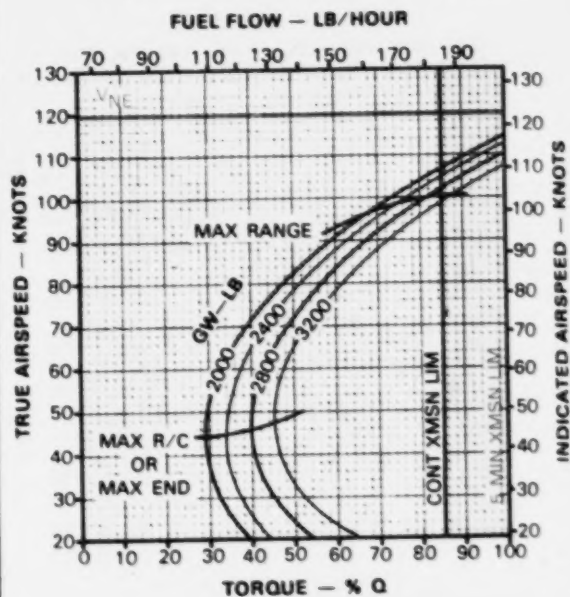
FAT = -15°C

CRUISE
OH-58C
T63-A-720

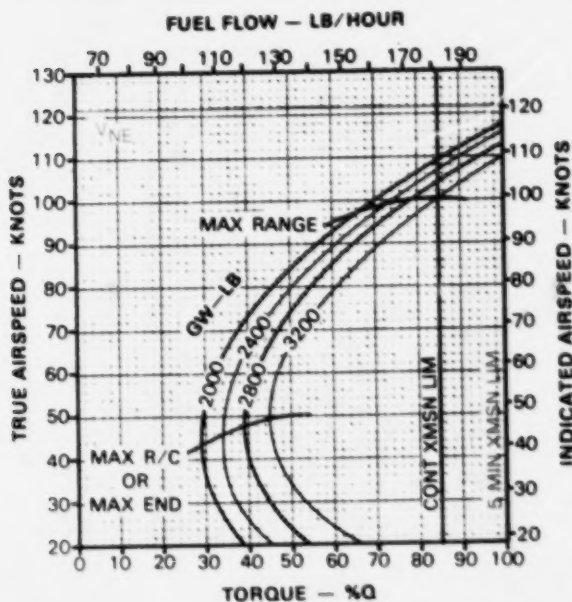
PRESSURE ALTITUDE — SEA LEVEL



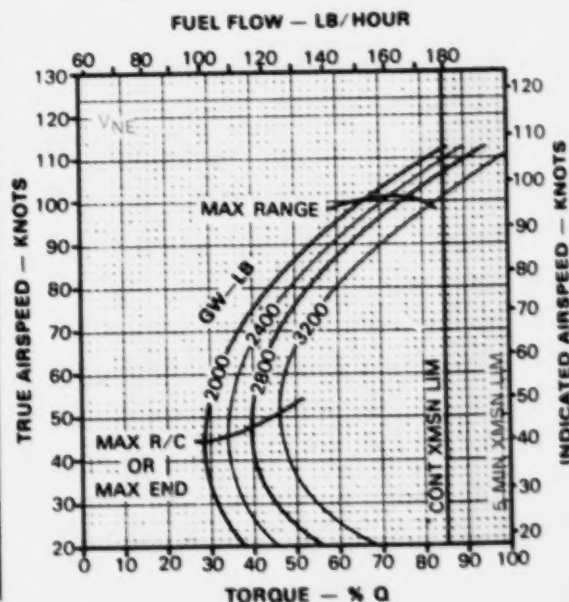
PRESSURE ALTITUDE — 2000 FEET



PRESSURE ALTITUDE — 4000 FEET



PRESSURE ALTITUDE — 6000 FEET



DATA BASIS: DERIVED FROM FLIGHT TEST, ASTA PROJECT NO 68-30, SEPTEMBER 1970

Figure 7-7. Cruise chart (Sheet 4 of 13)

CRUISE

PRESSURE ALTITUDE — 8000 FEET TO 14000 FEET

CLEAN CONFIGURATION JP-4/JP-5 FUEL OGE

100% RPM

FAT = -15°C

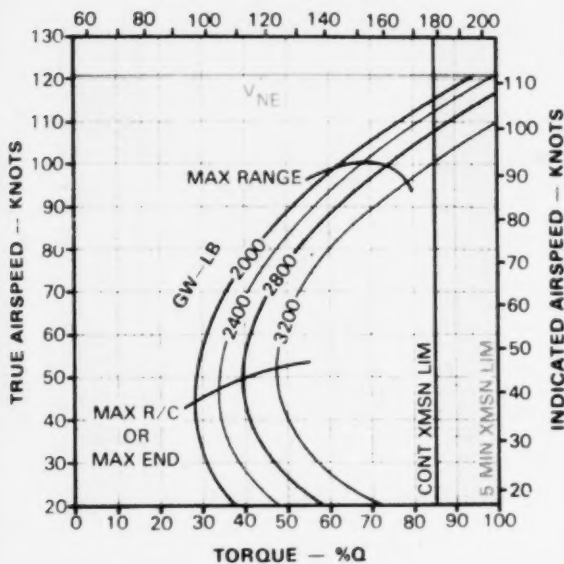
CRUISE

OH-58C

T63-A-720

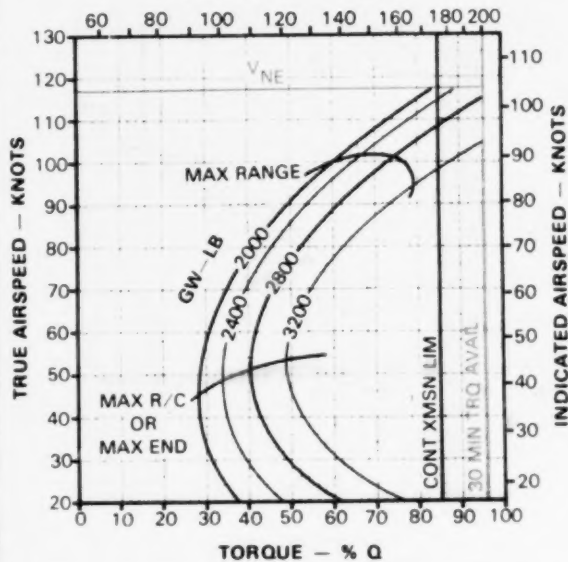
PRESSURE ALTITUDE — 8000 FEET

FUEL FLOW — LB/HOUR



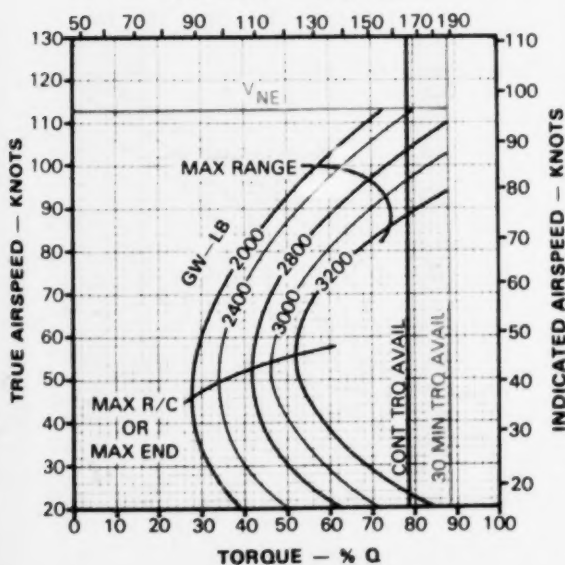
PRESSURE ALTITUDE — 10000 FEET

FUEL FLOW — LB/HOUR



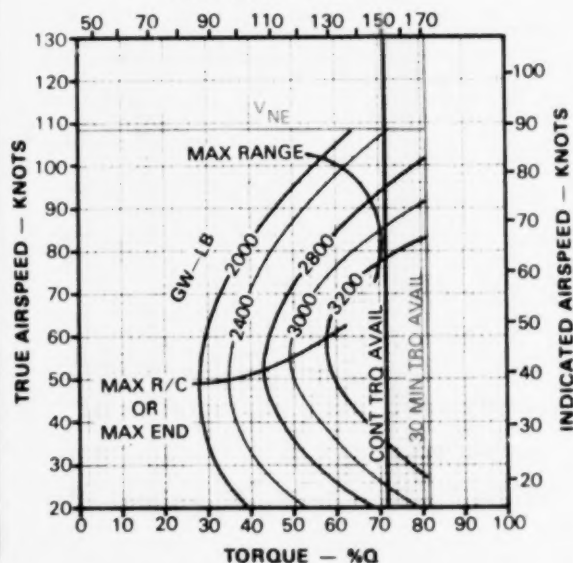
PRESSURE ALTITUDE — 12000 FEET

FUEL FLOW — LB/HOUR



PRESSURE ALTITUDE — 14000 FEET

FUEL FLOW — LB/HOUR



DATA BASIS: DERIVED FROM FLIGHT TEST, ASTA PROJECT NO 68-30, SEPTEMBER 1970

Figure 7-7. Cruise chart (Sheet 5 of 13)

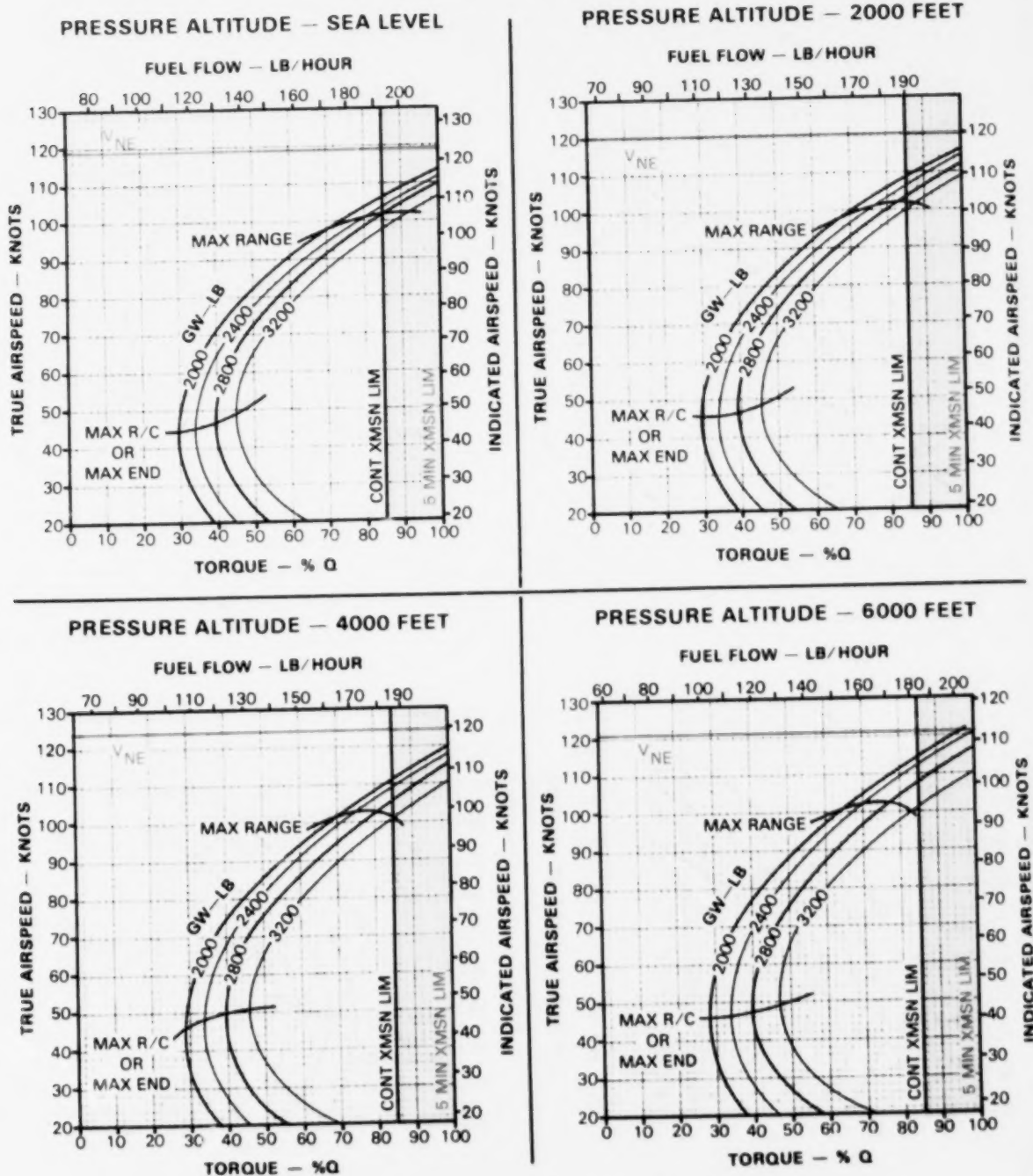
CRUISE

PRESSURE ALTITUDE — SEA LEVEL TO 6000 FEET
CLEAN CONFIGURATION JP-4/JP-5 FUEL OGE

100% RPM

FAT = 0°C

CRUISE
 OH-58C
 T63-A-720



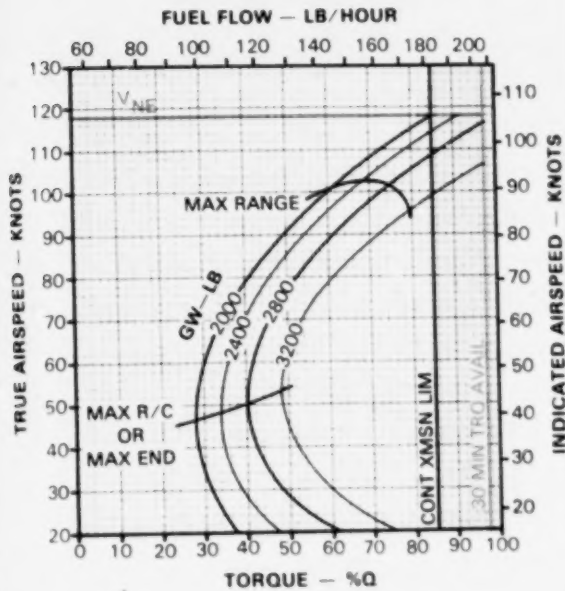
DATA BASIS: DERIVED FROM FLIGHT TEST, ASTA PROJECT NO. 68-30, SEPTEMBER 1970

Figure 7-7. Cruise chart (Sheet 6 of 13)

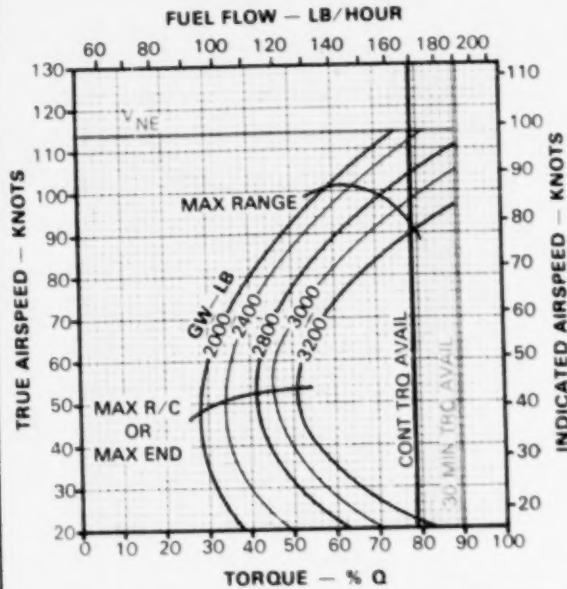
CRUISE
PRESSURE ALTITUDE — 8000 FEET TO 14000 FEET
CLEAN CONFIGURATION JP-4/JP-5 FUEL OGE
100% RPM
FAT = 0°C

CRUISE
OH-58C
T63-A-720

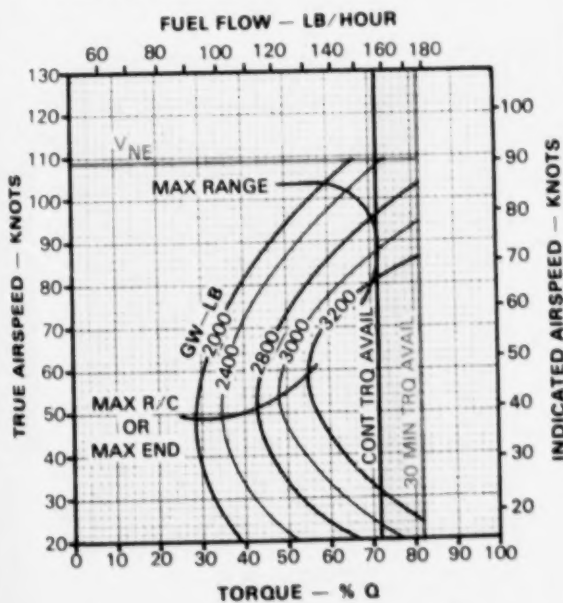
PRESSURE ALTITUDE — 8000 FEET



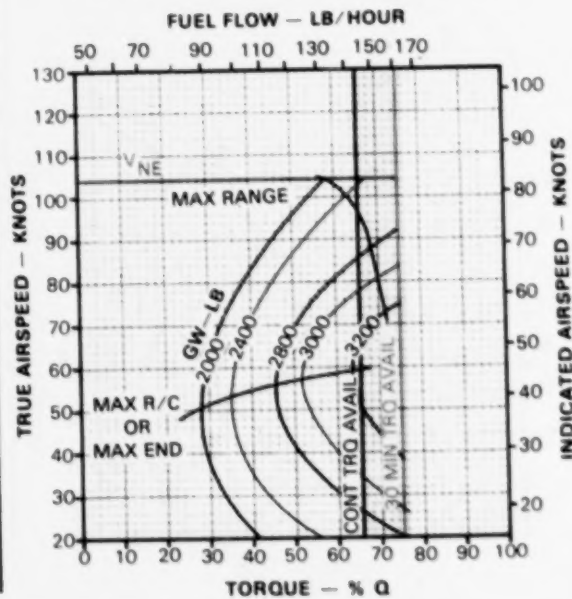
PRESSURE ALTITUDE — 10000 FEET



PRESSURE ALTITUDE — 12000 FEET



PRESSURE ALTITUDE — 14000 FEET



DATA BASIS: DERIVED FROM FLIGHT TEST, ASTA PROJECT NO 68-30, SEPTEMBER 1970

Figure 7-7. Cruise chart (Sheet 7 of 13)



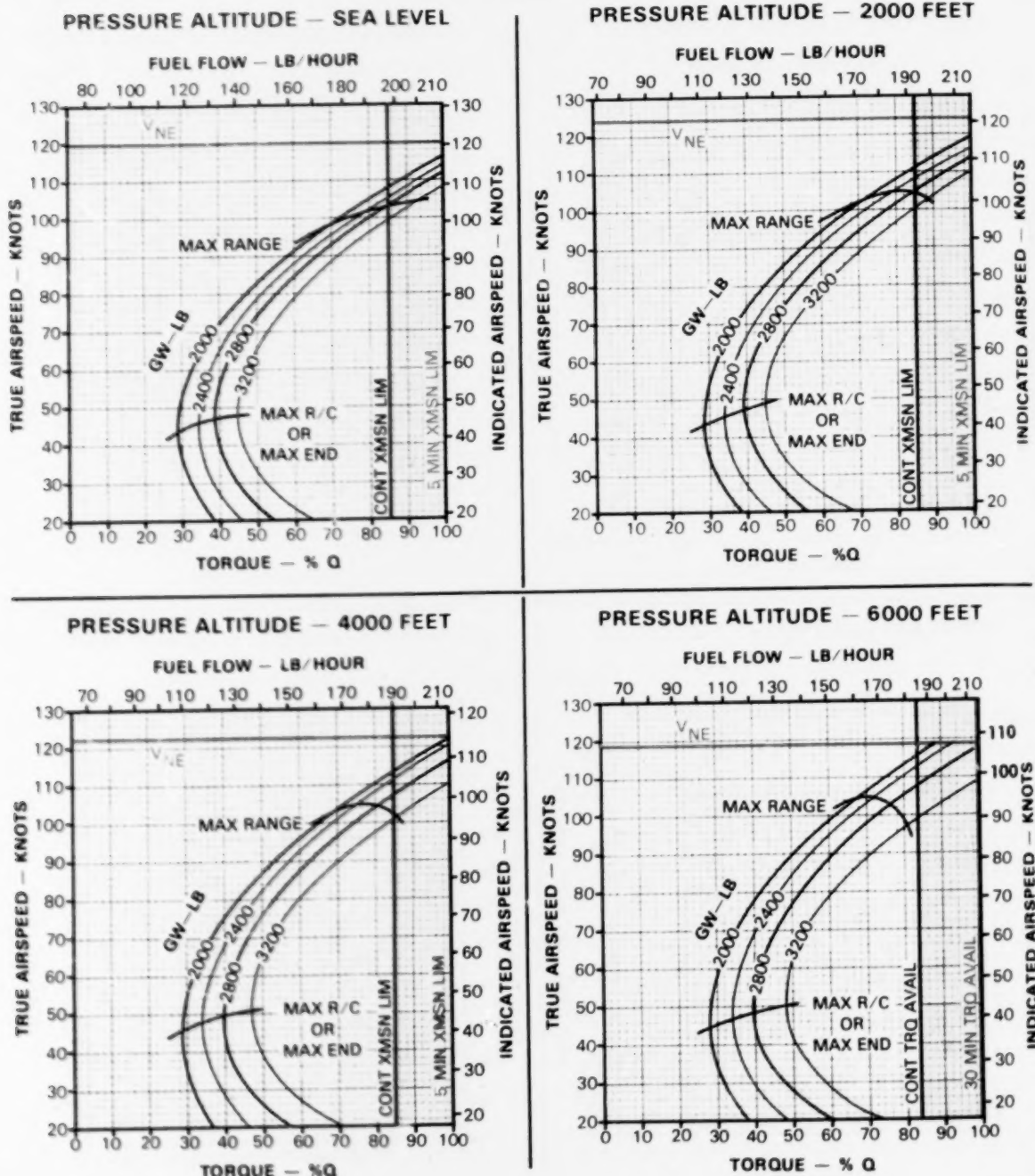
CRUISE

PRESSURE ALTITUDE — SEA LEVEL TO 6000 FEET
 CLEAN CONFIGURATION JP-4/JP-5 FUEL OGE
 100% RPM (ROTOR)

FAT = +15°C



CRUISE
 OH-58C
 T63-A-720



DATA BASIS: DERIVED FROM FLIGHT TEST, ASTA PROJECT NO 68-30, SEPTEMBER 1970

Figure 7-7. Cruise chart (Sheet 8 of 13)

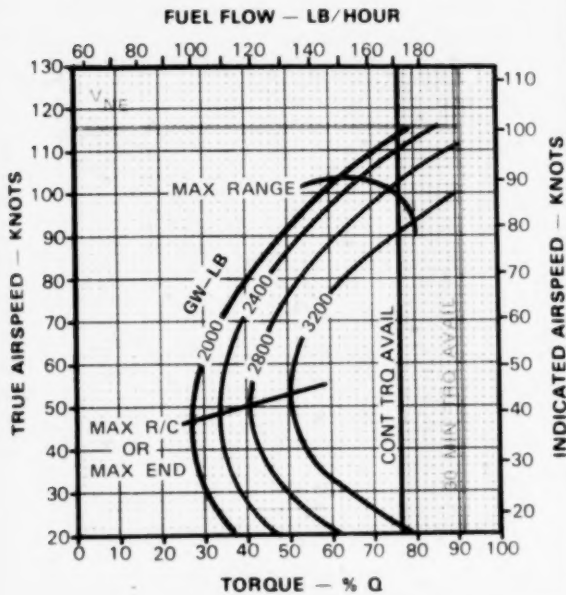


CRUISE
PRESSURE ALTITUDE — 8000 FEET TO 14000 FEET
CLEAN CONFIGURATION JP-4/JP-5 FUEL OGE
100% RPM

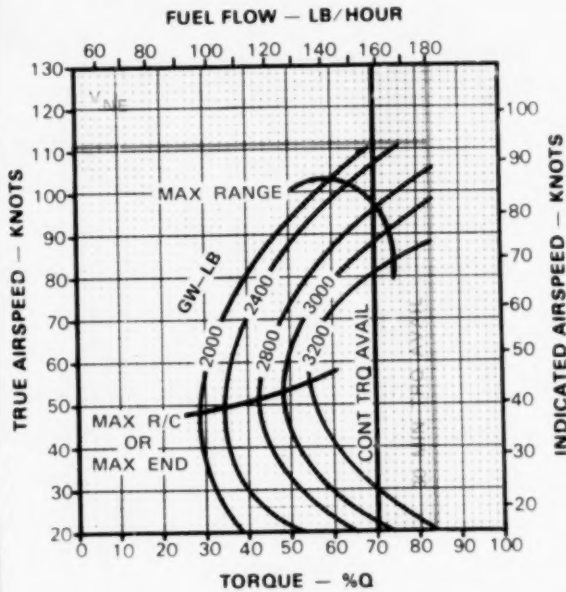
CRUISE
OH-58C
T63-A-720

FAT = +15°C

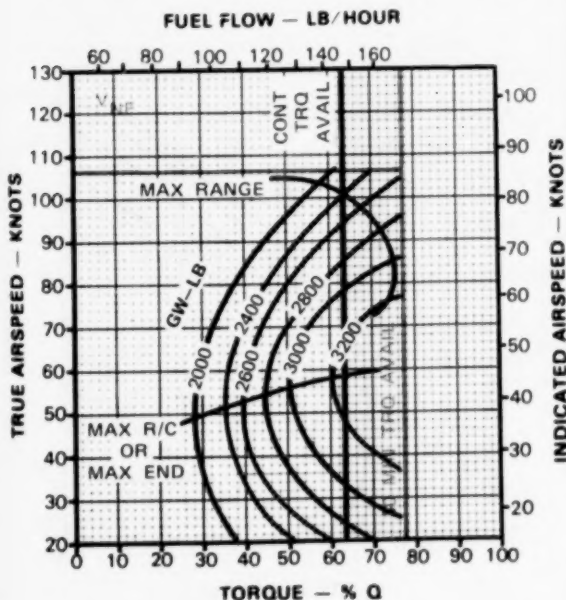
PRESSURE ALTITUDE — 8000 FEET



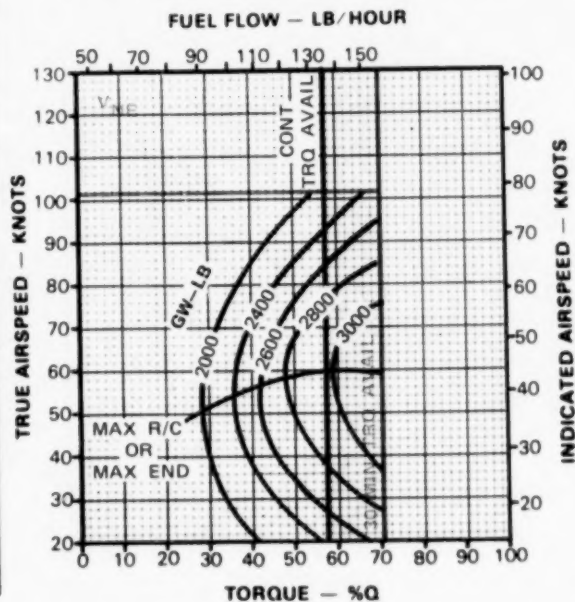
PRESSURE ALTITUDE — 10000 FEET



PRESSURE ALTITUDE — 12000 FEET



PRESSURE ALTITUDE — 14000 FEET



DATA BASIS: DERIVED FROM FLIGHT TEST, ASTA PROJECT NO 68-30, SEPTEMBER 1970

Figure 7-7. Cruise chart (Sheet 9 of 13)

CRUISE

PRESSURE ALTITUDE — SEA LEVEL TO 6000 FEET
CLEAN CONFIGURATION JP-4/JP-5 FUEL OGE

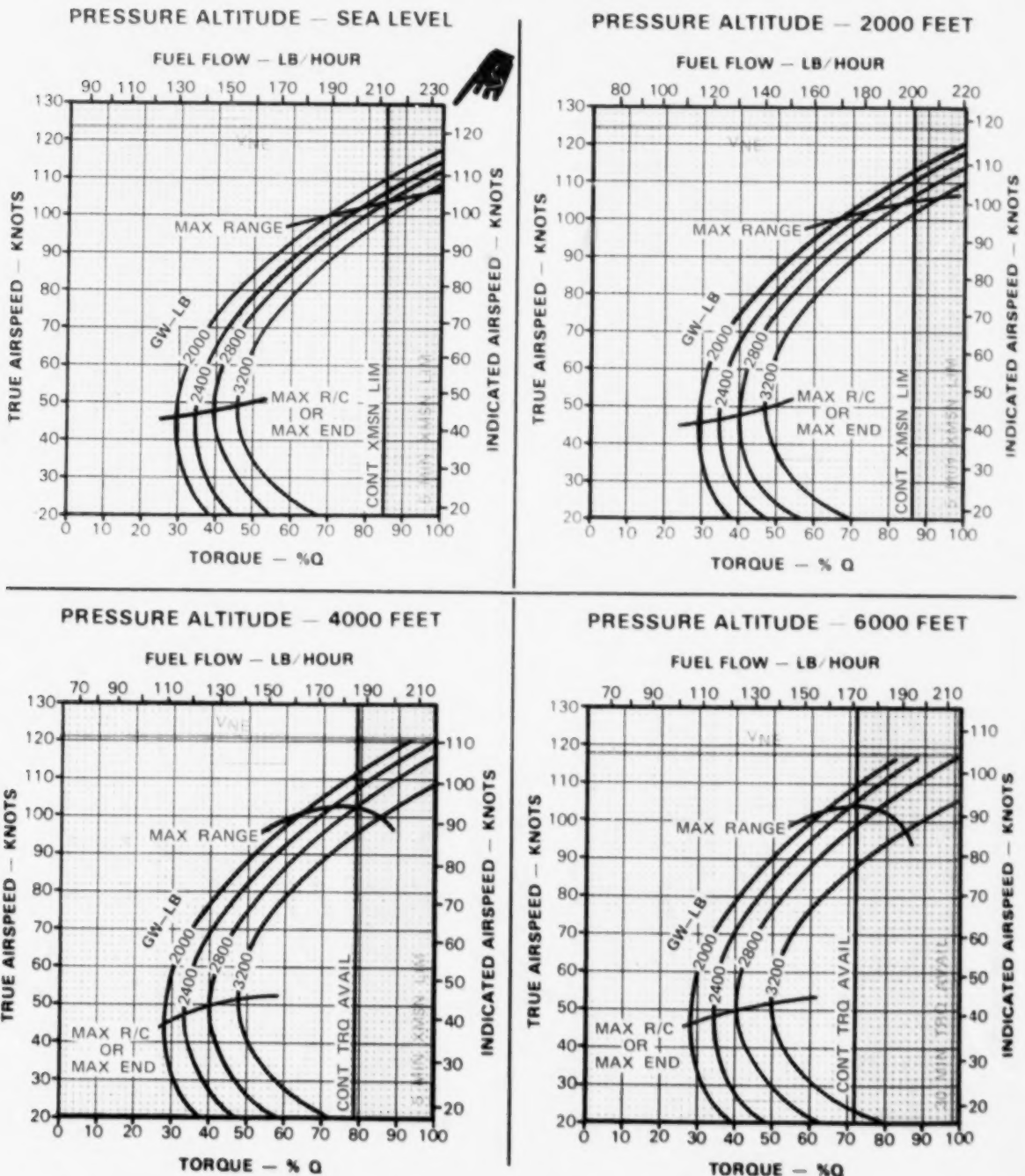
100% RPM

FAT = +30°C

CRUISE

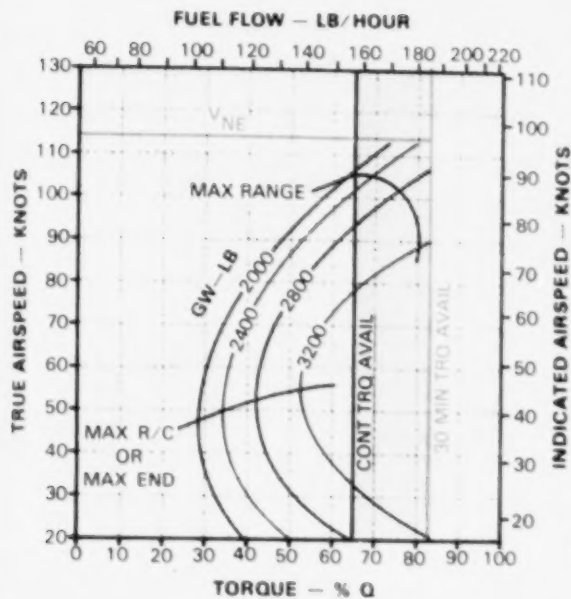
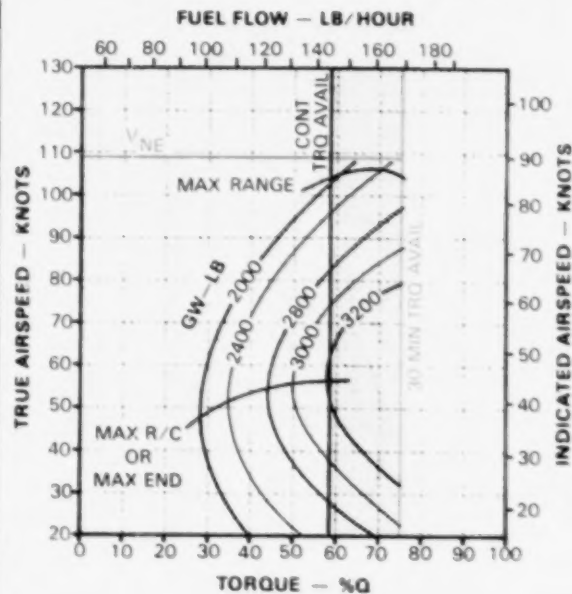
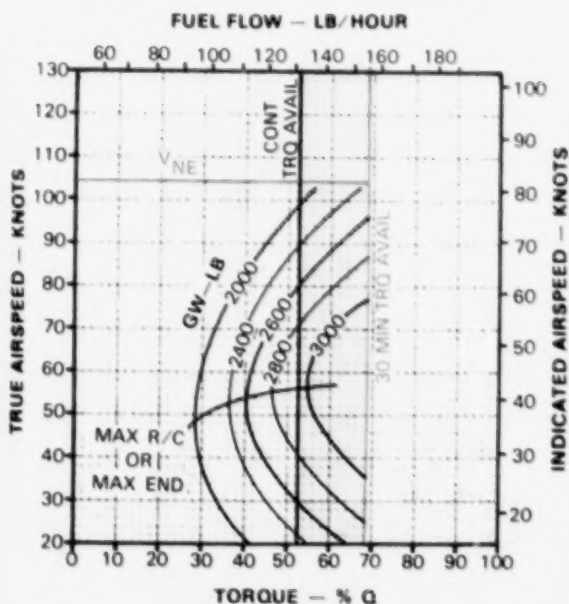
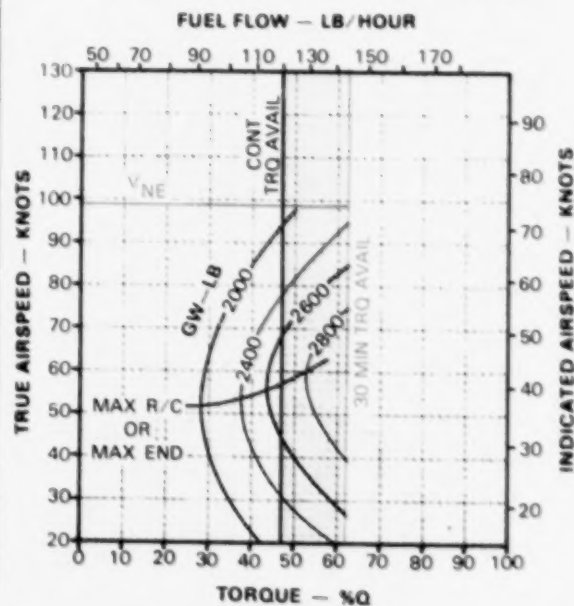
OH-58C

T63-A-720



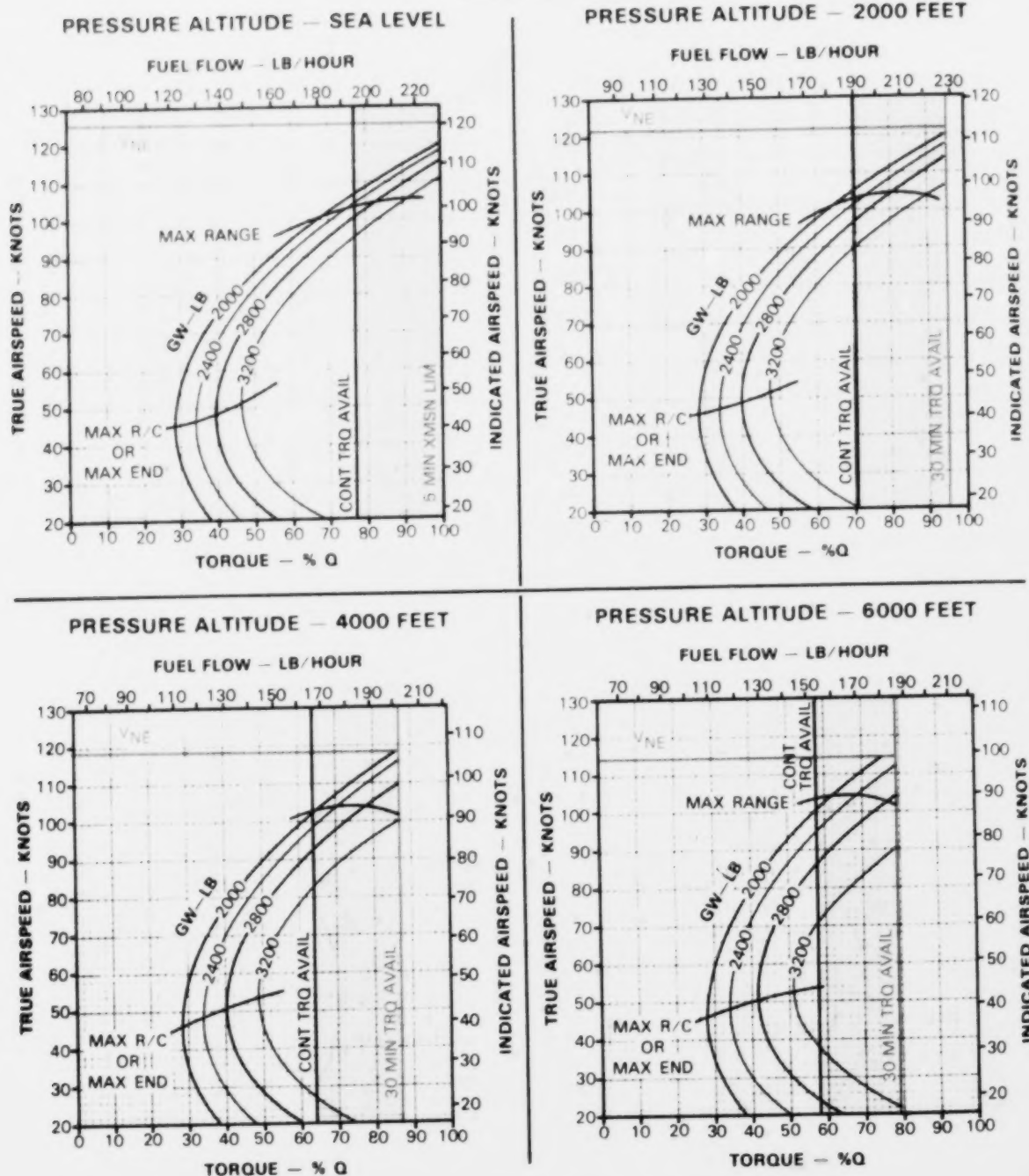
DATA BASIS: DERIVED FROM FLIGHT TEST, ASTA PROJECT NO 68-30, SEPTEMBER 1970

Figure 7-7. Cruise chart (Sheet 10 of 13)

CRUISE**PRESSURE ALTITUDE — 8000 FEET TO 14000 FEET****CLEAN CONFIGURATION JP-4/JP-5 FUEL OGE****100% RPM****FAT $\pm 30^{\circ}\text{C}$** **CRUISE****OH-58C****T63-A 720****PRESSURE ALTITUDE — 8000 FEET****PRESSURE ALTITUDE — 10000 FEET****PRESSURE ALTITUDE — 12000 FEET****PRESSURE ALTITUDE — 14000 FEET****DATA BASIS: DERIVED FROM FLIGHT TEST, ASTA PROJECT NO. 68-30, SEPTEMBER 1970****Figure 7-7. Cruise chart (Sheet 11 of 13)**

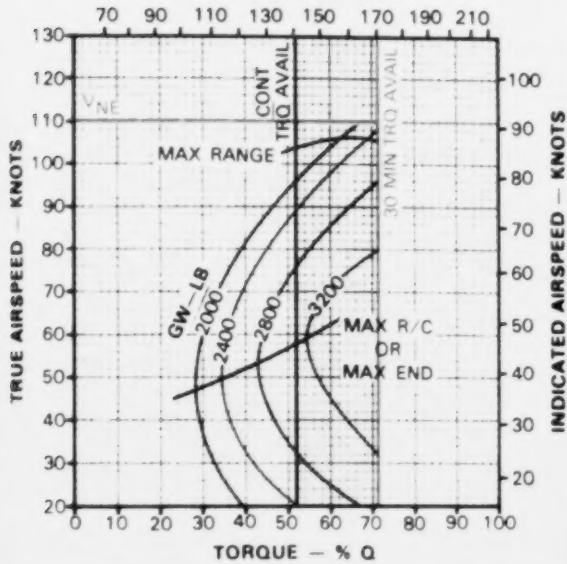
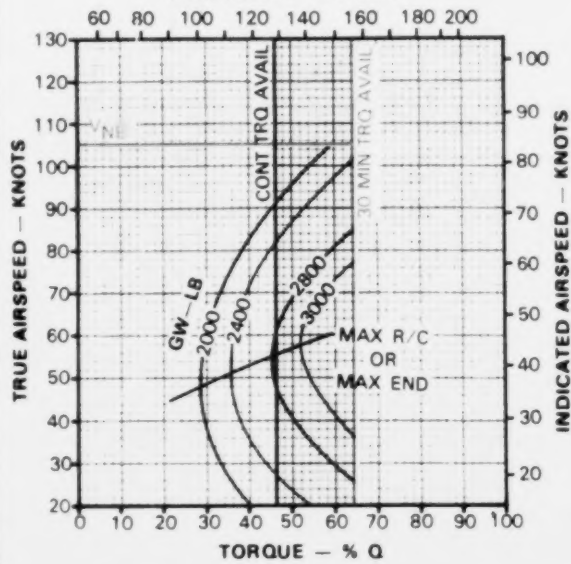
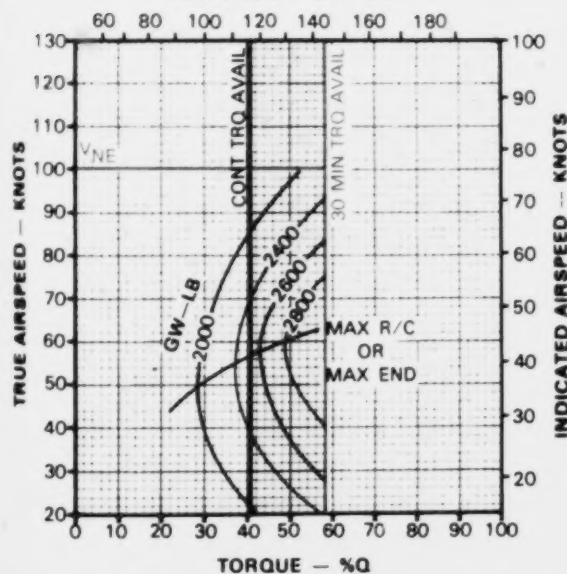
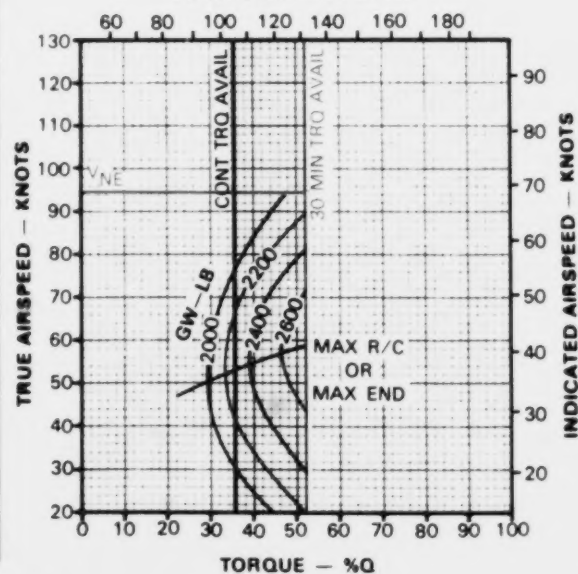
**CRUISE**

PRESSURE ALTITUDE — SEA LEVEL TO 6000 FEET
CLEAN CONFIGURATION JP-4/JP-5 FUEL OGE

100% RPM**FAT = +45°C****CRUISE****OH-58C****T63-A-720**

DATA BASIS: DERIVED FROM FLIGHT TEST, ASTA PROJECT NO 68-30, SEPTEMBER 1970

Figure 7-7. Cruise chart (Sheet 12 of 13)

CRUISE**PRESSURE ALTITUDE — 8000 FEET TO 14000 FEET****CLEAN CONFIGURATION JP-4/JP-5 FUEL OGE****100% RPM****FAT = +45°C****CRUISE****OH-58C****T63-A-720****PRESSURE ALTITUDE — 8000 FEET****FUEL FLOW — LB/HOUR****PRESSURE ALTITUDE — 10000 FEET****FUEL FLOW — LB/HOUR****PRESSURE ALTITUDE — 12000 FEET****FUEL FLOW — LB/HOUR****PRESSURE ALTITUDE — 14000 FEET****FUEL FLOW — LB/HOUR****DATA BASIS: DERIVED FROM FLIGHT TEST, ASTA PROJECT NO 68-30, SEPTEMBER 1970****Figure 7-7. Cruise chart (Sheet 13 of 13)**

Section VII. DRAG

7-27. Description.

The drag chart (figure 7-8) shows the torque change required for flight due to drag area change as a result of external configuration changes. Note that the figure shows drag area change due to specific configurations.

7-28. Use of Chart.

The primary use of the chart is illustrated by the example. To determine the change in torque it is necessary to know the drag area change, the true airspeed, the pressure altitude and the free air temperature. Enter at the known drag area

change, move right to TAS, move down to pressure altitude, move left to FAT, then move down and read change in torque. In addition, by entering the chart in the opposite direction, drag area change may be found from a known torque change.

This chart is used to adjust cruise charts (figure 7-7, sheets 1 through 13) for appropriate torque and fuel flow due to equivalent flat plate drag area change (ΔF).

7-29. Conditions.

The drag chart is based upon 100% rpm.

DRAG

DRAG
OH-58C
T63 A-720

EXAMPLE

WANTED

CHANGE IN TORQUE REQUIRED
DUE TO EQUIVALENT FLAT PLATE DRAG AREA
CHANGE, (ΔF) FROM ALL DOORS OFF
CONFIGURATION

KNOWN

DRAG AREA CHANGE = 1.6 SQ FT
TRUE AIRSPEED = 120 KNOTS
PRESSURE ALTITUDE = SEA LEVEL
FAT = -20°C

METHOD

ENTER DRAG AREA CHANGE HERE
MOVE RIGHT TO TRUE AIRSPEED
MOVE DOWN TO PRESSURE ALTITUDE
MOVE LEFT TO FAT
MOVE DOWN, READ CHANGE IN TORQUE = 11% Q

DATA BASIS: CALCULATED DATA

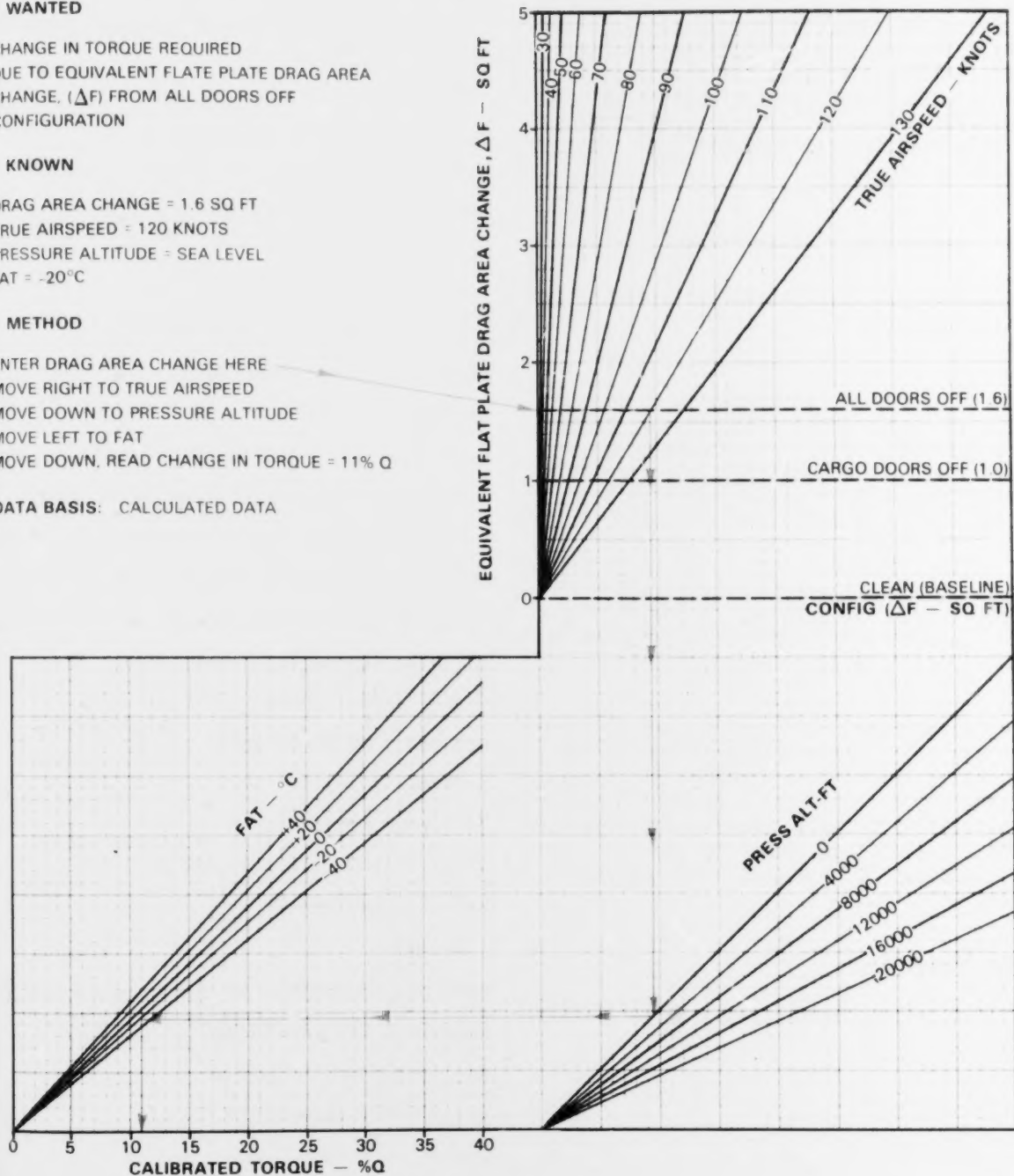


Figure 7-8. Drag chart

Section VIII. CLIMB — DESCENT

7-30. Description — Climb-Descent Chart.

The upper grid of the climb descent chart (figure 7 9) shows the change in torque (above or below torque required for level flight under the same gross weight, and atmospheric conditions) to obtain a given rate of climb or descent. The lower grid of the chart shows the relationships between descent-climb angles, airspeeds, and rates of descent or climb.

7-31. Use of Climb-Descent Chart.

The primary uses of the chart are illustrated by the chart examples.

a. The torque change obtained from the upper grid scale must be added to the torque required for level flight (for climb) — or subtracted from the torque required for level flight (for descent) — obtained from the appropriate cruise chart in order to obtain a total climb or descent torque.

b. By entering the bottom of the upper grid with a known torque change, moving upward to the gross weight, and left to the corresponding rate of climb or descent may also be obtained.

c. By entering the lower grid chart with any two of the three parameters (rate of climb/descent can be read directly from the chart. For example, by entering the chart with a known TAS of 65 knots, moving upward to a known climb angle of nine degrees, and then moving left, the corresponding rate of climb (1025 feet per minute) is obtained.

7-32. Conditions.

The climb-descent chart is based on the use of 100% rpm.

EXAMPLE

WANTED (SEE FIGURE 7-7, PAGE 7-29)

EXCESS TORQUE AVAILABLE FOR CLIMB AT MAXIMUM CONTINUOUS POWER

KNOWN

CLEAN CONFIGURATION

GROSS WEIGHT = 3200 LB

PRESSURE ALTITUDE = 14000 FEET

FAT = -30°C

METHOD

LOCATE CHART (FIGURE 7-7, PAGE 7-29)

FIND INTERSECTION OF 3200 LB GROSS WEIGHT LINE

WITH THE MAXIMUM RATE OF CLIMB LINE ➔ 1

MOVE DOWN, READ TORQUE REQUIRED = 53% Q

FIND INTERSECTION OF 3200 LB GROSS WEIGHT LINE

WITH THE CONTINUOUS TORQUE AVAILABLE LINE ➔ 2

MOVE DOWN, READ TORQUE AVAILABLE 78% Q

EXCESS TORQUE AVAILABLE = $(78 - 53) = 25\% Q$

WANTED (SEE FIGURE 7-9, PAGE 7-43)

RATE OF CLIMB AT 70 KIAS

MAXIMUM CONTINUOUS POWER

KNOWN

EXCESS TORQUE AVAILABLE

(FROM FIGURE 7-7, PAGE 7-29) = 25% Q

GROSS WEIGHT = 3200 LB

METHOD

ENTER CALIBRATED TORQUE SCALE HERE ➔ 3

MOVE UP TO GROSS WEIGHT LINE

MOVE LEFT TO RATE OF CLIMB OR

DESCENT SCALE, READ RATE OF

CLIMB = 1290 FT/MIN

CLIMB — DESCENT

100% RPM

CLIMB — DESCENT
OH-58C
T63 A-720

EXAMPLE A

WANTED

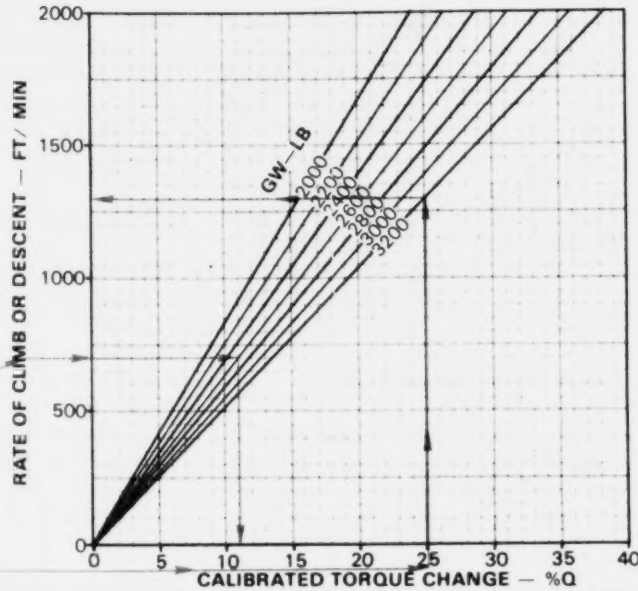
CALIBRATED TORQUE CHANGE
FOR DESIRED R/C OR R/D

KNOWN OR ESTIMATED

GROSS WEIGHT = 2600 LB
DESIRED R/C = 700 FT/MIN

METHOD

ENTER R/C HERE
MOVE RIGHT TO GROSS WEIGHT
MOVE DOWN, READ CALIBRATED
TORQUE CHANGE = 11%Q



REMARK: TORQUE CHANGE IS THE DIFFERENCE BETWEEN THE TORQUE USED DURING THE CLIMB OR DESCENT AND THE TORQUE REQUIRED FOR LEVEL FLIGHT AT THE SAME CONDITIONS (ALTITUDE, GROSS WEIGHT, AIRSPEED, CONFIGURATION, ETC)

APPROACH (CLIMB) ANGLE

EXAMPLE B

WANTED

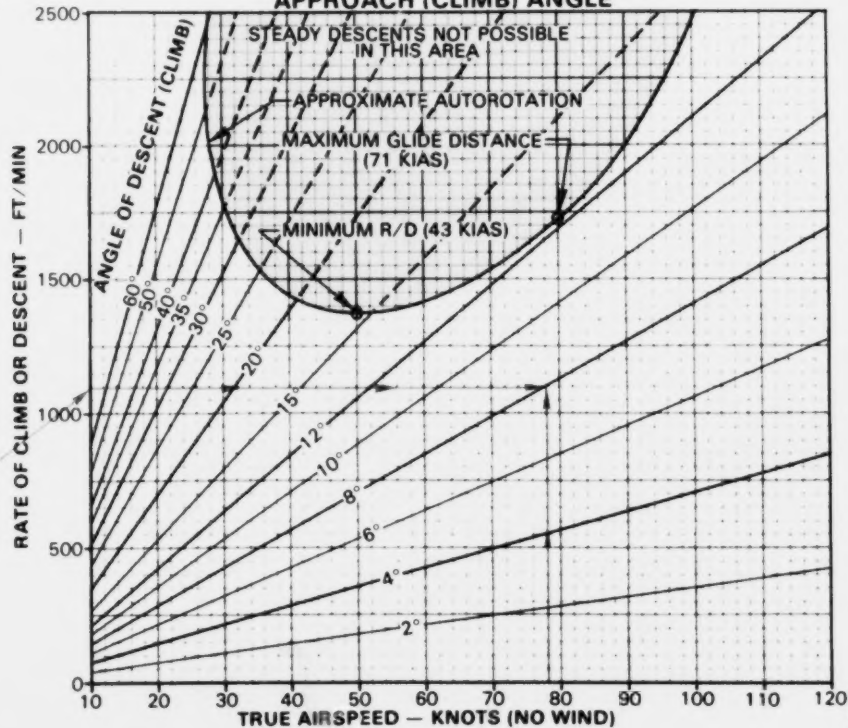
DESCENT ANGLE

KNOWN OR ESTIMATED

DESIRED R/D = 1100 FT/MIN
TAS = 78 KNOTS

METHOD

ENTER R/D HERE
MOVE RIGHT TO 78 KNOTS TAS
READ ANGLE OF DESCENT = 8°



DATA BASIS: DERIVED FROM FLIGHT TEST OF SIMILAR TYPE AIRCRAFT AND CALCULATED DATA

Figure 7-9. Climb—descent chart

7-33. Description — Climb Performance Charts.

The climb performance charts (figure 7-10) represent a synthesis of the cruise charts to ease estimation of the climb portion of the flight plan. The charts show relationships between gross weight, initial and final altitude and temperatures, and time to climb, distance covered while climbing, and fuel expended while climbing. The chart (figure 7-10, sheet 1 of 2) is presented for (continuous operation) climbing at maximum torque (30 minute operation) and the second chart (figure 7-10, sheet 2 of 2) is presented for climbing. Both charts may be used for all drag configurations.

7-34. Use of Climb Performance Charts.

Enter at the top left at the known gross weight, move right to the initial altitude, move down to the free air temperature at that altitude, and move left and record time, distance, and fuel consumed for

that altitude. Enter again at the gross weight, move right to the final altitude, move down to the free air temperature at that altitude, and move right and record the time, distance, and fuel for that altitude. Subtract the time, distance, and fuel values of the initial altitude-temperature condition from those of the final altitude-temperature condition to find the time to climb, distance covered and fuel used while climbing.

7-35. Conditions — Climb Performance Charts.

The charts represent climb at optimum condition, that is minimum power required and stated torque available. Climb is assumed to be at 50 knots IAS as this is near the airspeed for maximum rate of climb at most atmospheric conditions. Warmup and taxi fuel are not included in fuel flow calculations. Climb performance is calculated for 100% rpm. The charts are based upon a no-wind condition, therefore, distance traveled will not be valid when winds are present.

CLIMB PERFORMANCE

(MAXIMUM TORQUE AVAILABLE — 30 MINUTE OPERATION)

100% RPM CLIMB AT 50 KIAS

CLIMB
OH-58C
T63-A-720

EXAMPLE

WANTED

MAXIMUM POWER
TIME TO CLIMB
DISTANCE TRAVELED
FUEL USED

KNOWN

GROSS WEIGHT = 2800 LBS
INITIAL PRESSURE ALTITUDE = 2000 FT
FINAL PRESSURE ALTITUDE = 12000 FT
INITIAL FAT = 20°C
FINAL FAT ESTIMATED AT 0°C

METHOD

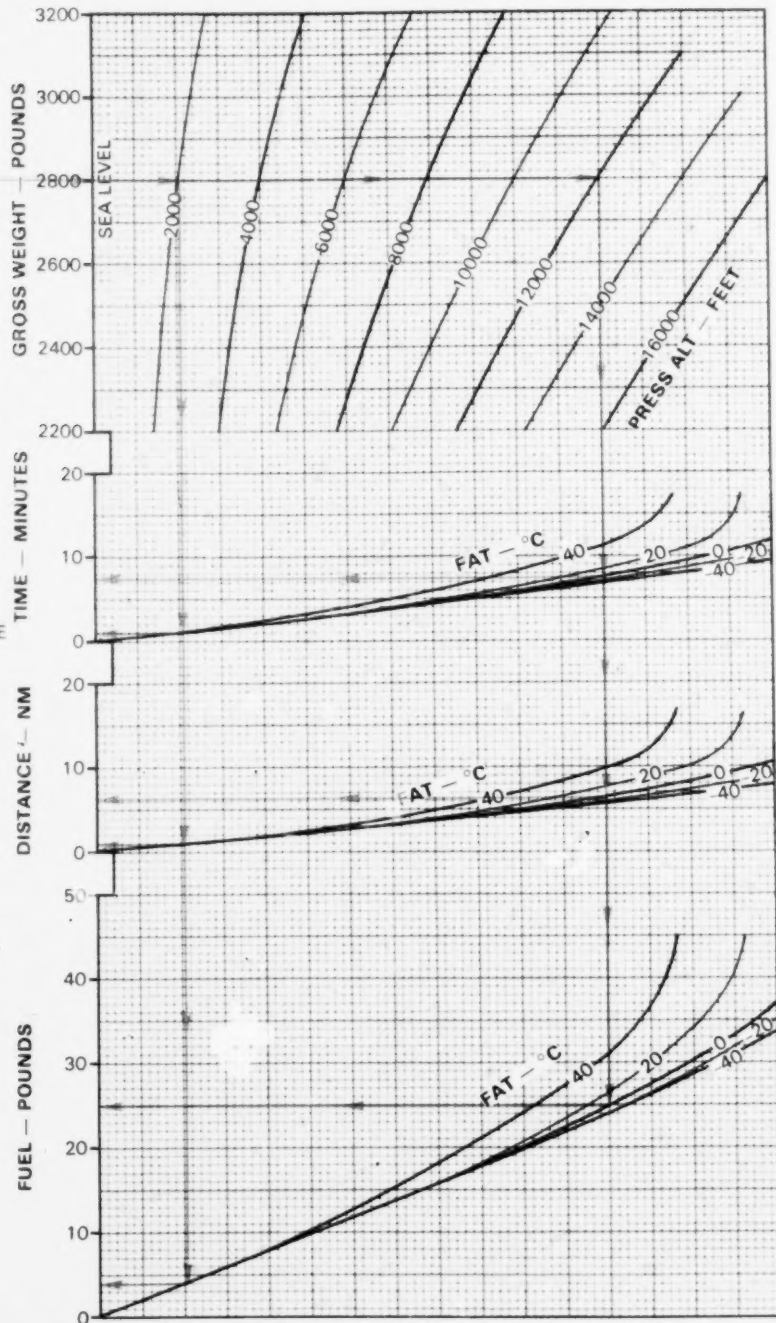
ENTER GROSS WEIGHT HERE
MOVE RIGHT TO INITIAL PRESSURE ALTITUDE
MOVE DOWN TO INITIAL FAT ON
TIME, DISTANCE, AND FUEL CHARTS
MOVE LEFT, READ:

TIME = 10 MIN
DISTANCE = 10 NM
FUEL = 40 LB

REENTER AT SAME GROSS WEIGHT
MOVE RIGHT TO FINAL PRESSURE ALTITUDE
MOVE DOWN TO FINAL FAT, ON TIME,
DISTANCE, AND FUEL CHARTS
MOVE LEFT, READ:

TIME = 75 MIN
DISTANCE = 64 NM
FUEL = 250 LB

TIME TO CLIMB = (75 - 10) = 65 MIN
DISTANCE COVERED = (64 - 10) = 54 NM
FUEL USED = (250 - 40) = 210 LB



DATA BASIS: DERIVED FROM FLIGHT TEST OF SIMILAR TYPE AIRCRAFT

Figure 7-10. Climb performance (Sheet 1 of 2)

Change 29 7-45/(7-46 blank)

CLIMB PERFORMANCE (CONTINUOUS OPERATION) 100% RPM CLIMB AT 50 KIAS

CLIMB
OH-58C
T63-A 720

EXAMPLE

WANTED

CONTINUOUS POWER
TIME TO CLIMB
DISTANCE TRAVELED
FUEL USED

KNOWN

GROSS WEIGHT = 2800 LBS
INITIAL PRESSURE ALTITUDE = 2000 FT
FINAL PRESSURE ALTITUDE = 12000 FT
INITIAL FAT = 20°C
FINAL FAT ESTIMATED AT 0°C

METHOD

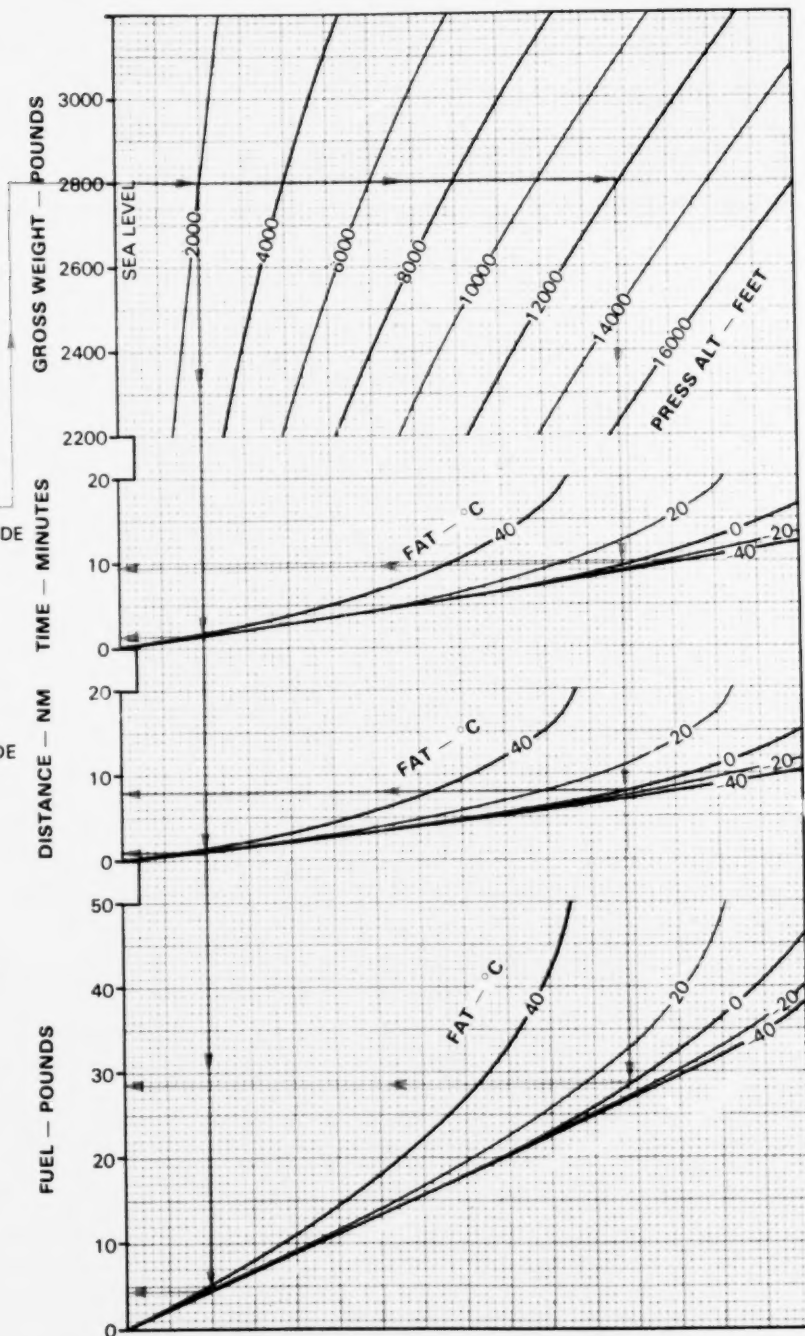
ENTER GROSS WEIGHT HERE
MOVE RIGHT TO INITIAL PRESSURE ALTITUDE
MOVE DOWN TO INITIAL FAT ON
TIME, DISTANCE, AND FUEL CHARTS
MOVE LEFT, READ:

TIME = 1.3 MIN
DISTANCE = 1.0 NM
FUEL = 4.7 LB

REENTER AT SAME GROSS WEIGHT
MOVE RIGHT TO FINAL PRESSURE ALTITUDE
MOVE DOWN TO FINAL FAT, ON TIME,
DISTANCE, AND FUEL CHARTS
MOVE LEFT, READ:

TIME = 9.6 MIN
DISTANCE = 8.0 NM
FUEL = 28.7 LB

TIME TO CLIMB = $(9.6 - 1.3) = 8.3$ MIN
DISTANCE COVERED = $(8.0 - 1.0) = 7.0$ NM
FUEL USED = $(28.7 - 4.7) = 24.0$ LB



DATA BASIS: DERIVED FROM FLIGHT TEST OF SIMILAR TYPE AIRCRAFT

Figure 7-10. Climb performance (Sheet 2 of 2)

Section IX. IDLE FUEL FLOW

7-36. Description.

The idle fuel flow chart (figure 7-11) shows the fuel flow at flight idle and at flat pitch with 100% rpm.

7-37. Use of Chart.

The primary use of the chart is illustrated by the example. To determine the idle flow, it is necessary to know the idle condition, pressure altitude, and

free air temperature. Enter at the pressure altitude, move right to FAT in appropriate grid, then move down and read fuel flow on the scale corresponding to the condition. Refer to the cruise charts to obtain fuel flow for cruise power conditions.

7-38. Conditions.

This chart is based upon the use of JP-4 or JP-5 fuel and 100% rpm.

IDLE FUEL FLOW **JP-4 FUEL**

IDLE FUEL FLOW
OH 58C
T63 A 720

EXAMPLE

WANTED

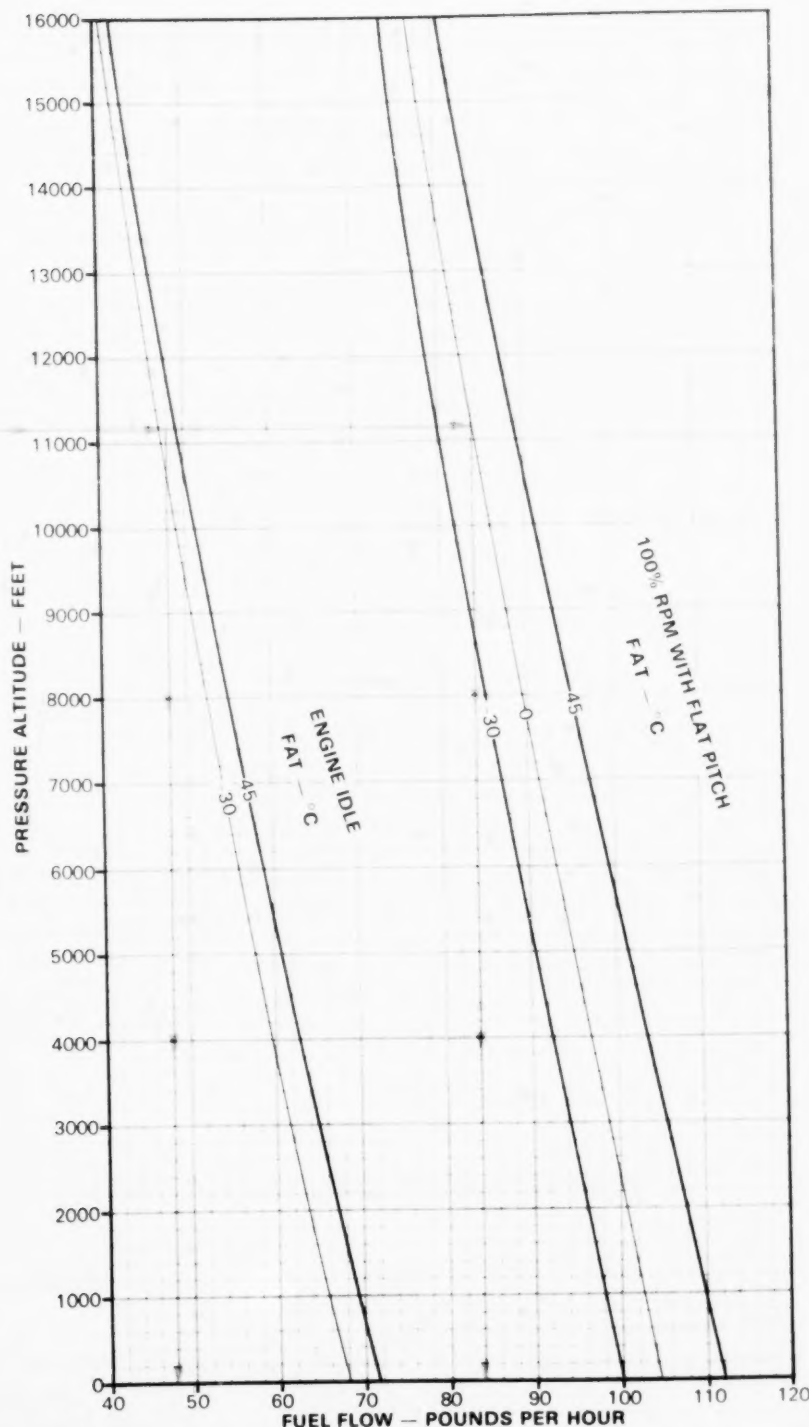
FUEL FLOW AT FLAT PITCH
AND ENGINE IDLE

KNOWN

PRESSURE ALTITUDE = 11200 FEET
FAT = 0°C

METHOD

ENTER PRESSURE ALTITUDE HERE
MOVE RIGHT TO (FLAT PITCH)
FAT = 0°C
MOVE DOWN, READ FLAT PITCH
FUEL FLOW = 84 LB/HR
REENTER PRESSURE ALTITUDE HERE
MOVE RIGHT TO (ENGINE IDLE)
FAT = 0°C
MOVE DOWN READ ENGINE IDLE
FUEL FLOW = 48 LB/HR



DATA BASIS: CALCULATED FROM MODEL SPEC 876, 25 JULY 1975.
CORRECTED FOR INSTALLATION LOSSES BASED ON FLIGHT TEST OF SIMILAR TYPE AIRCRAFT

Figure 7-11. Idle fuel flow chart

CHAPTER 8

NORMAL PROCEDURES

Section I. MISSION PLANNING

8-1. Mission Planning.

Mission planning begins when the mission is assigned and extends to the preflight check of the helicopter. It includes, but is not limited to, checks of operating limits and restrictions; weight balance and loading; performance; publications; flight plan and crew and passenger briefings. The pilot in command shall ensure compliance with the contents of this manual that are applicable to the mission.

8-2. Operating Limits and Restrictions.

The minimum, maximum, normal and cautionary operational range represent careful aerodynamic and structural calculations, substantiated by flight test data. These limitations must be adhered to during all phases of the mission. Refer to Chapter 5, OPERATING LIMITS AND RESTRICTIONS, for detailed information.

8-3. Weight, Balance and Loading.

The helicopter must be loaded, cargo and passengers secured, and weight and balance verified in accordance with chapter 6, WEIGHT, BALANCE AND LOADING. This helicopter requires a weight and balance clearance in accordance with AR 95-16. The helicopter weight and center-of-gravity conditions must be within the limits prescribed in chapter 6.

8-4. Performance.

Refer to Chapter 7, PERFORMANCE DATA, to determine the capability of the helicopter for the entire mission. Consideration must be given to changes in performance resulting from variations in loads, temperatures, and pressure altitudes. Record the data on the Performance Planning Card for use in completing the flight plan and for reference throughout the mission.

8-5. Flight Plan.

A flight plan must be completed and filed in accordance with AR 95-1, DOD FLIP, and local regulations.

8-6. Crew And Passenger Briefing.

A crew and passenger briefing must be conducted to ensure a thorough understanding of individual and team responsibilities. The briefing should include, but not be limited to, copilot, observer crew chief, and ground crew responsibilities and the coordination necessary to complete the mission in the most efficient manner. A review of visual signals is desirable when ground guides do not have a direct voice communications link with the crew.

8-7. Danger Areas.

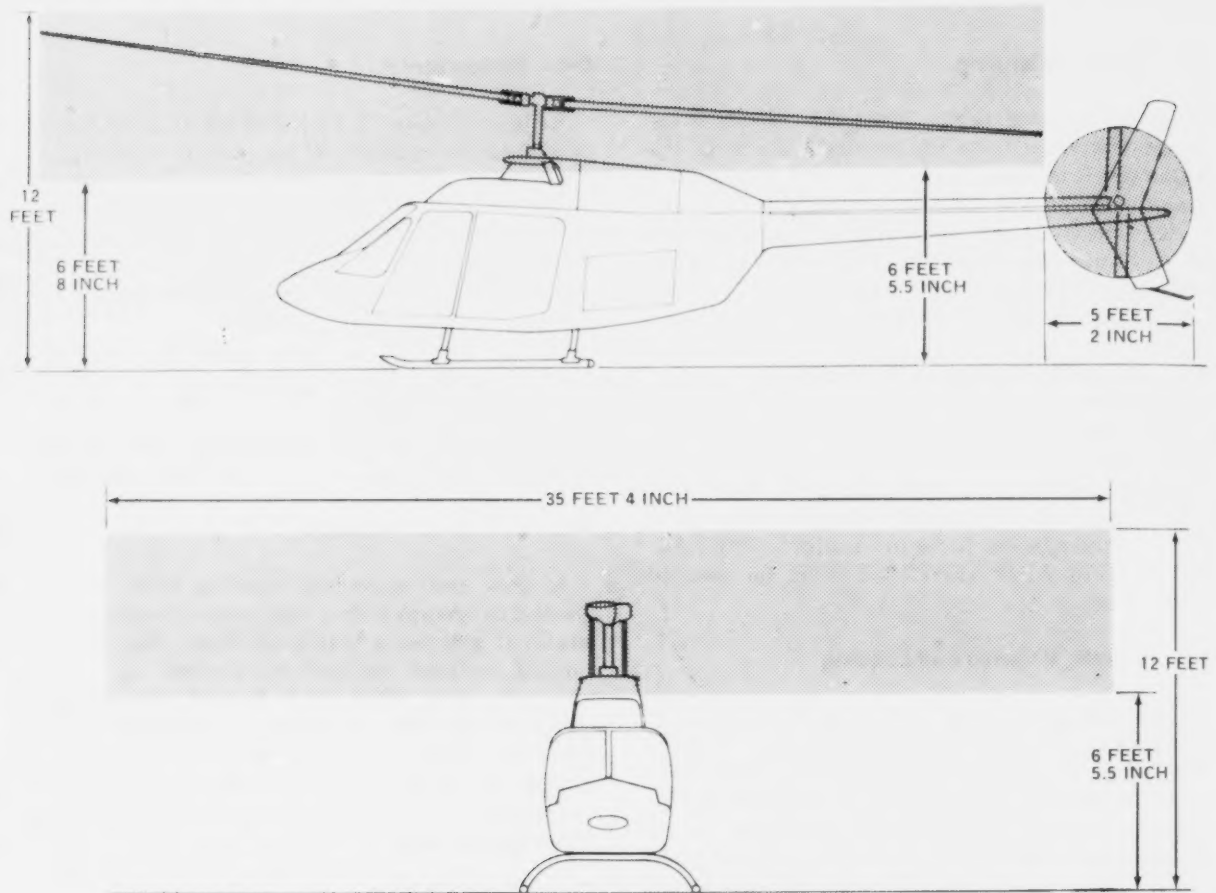
Refer to Figure 8-1.

Section II. OPERATING PROCEDURES AND MANEUVERS

8-8. Operating Procedures and Maneuvers.

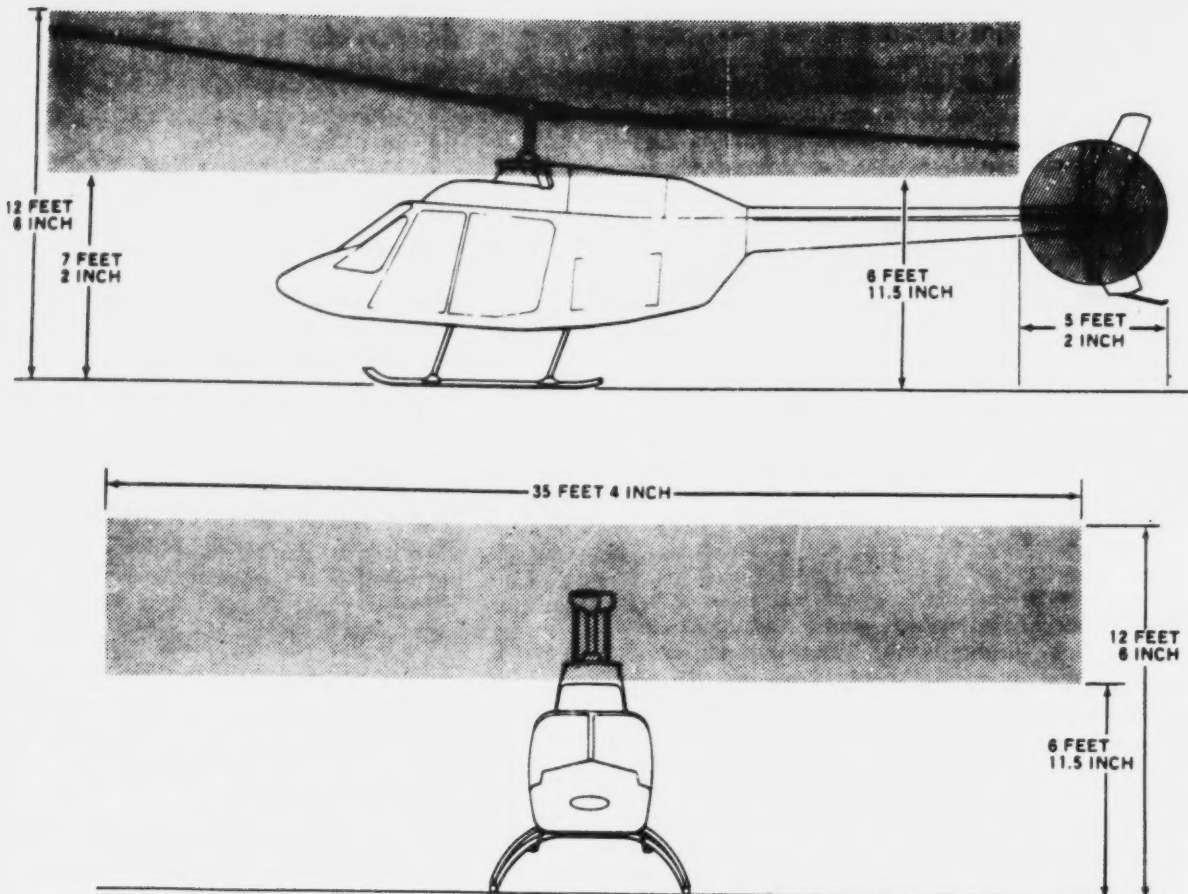
This section deals with normal procedures, and includes all steps necessary to ensure safe and efficient operation of the helicopter from the time a preflight begins until the flight is completed and the helicopter is parked and secured. Unique feel, characteristics and

reaction of the helicopter during various phases of operation and the techniques and procedures used for taxing, takeoff, climb, etc., are described, including precautions to be observed. Your flying experience is recognized; therefore, basic flight principles are avoided. Only the duties of the minimum crew necessary for the actual operation of the helicopter are included.



206900-245

Figure 8-1. Danger areas standard skid gear (Sheet 1 of 2)



206900-292

Figure 8-1. Danger areas high skid gear (Sheet 2 of 2)

8-9. General Information.

Additional crew duties are covered as necessary in Section VI, CREW DUTIES. Procedures specifically related to instrument flight that are different from normal procedures are covered in this section following normal procedures. Descriptions of functions, operations, and effects of controls are covered in Section IV, FLIGHT CHARACTERISTICS, and are repeated in this section only when required for emphasis. Checks that must be performed under adverse environmental conditions, such as desert and cold weather operations, supplement normal procedures checks in this section and are covered in Section V, ADVERSE ENVIRONMENTAL CONDITIONS.

8-10. Checklist.

Normal procedures are given primarily in checklist form, and amplified as necessary in accompanying paragraph form when a detailed description of a procedure or maneuver is required. A condensed version of the amplified checklist, omitting all explanatory text, is contained in the Operators and Crewmember's Checklist, TM 55-1520-235-CL. To provide for easier cross-referencing, the procedural steps are numbered to coincide with the corresponding numbered steps in TM 55-1520-235-CL.

8-11. Checks.

The checklist includes items for day, night and instrument flights with annotative indicators immediately preceding the check to which they are pertinent; (N) for night operations only; (I) for instrument operations only; and (O) to indicate a requirement if the equipment is installed. The symbol ★ preceding steps of the checklist indicates that detailed procedures for those checks are included in the performance checks section located at the back of the condensed checklist (TM 55-1520-235-CL). When a helicopter is flown by the same flight crew on a mission requiring intermediate stops it is not necessary to perform all the normal checks. The steps that are essential for safe helicopter operation on intermediate stops are designated as "thru-flight" checks. An asterisk (*) indicates that performance of steps is mandatory for all "thru-flights" when there has been no change in crew. The asterisk applies only to checks performed prior to takeoff.

8-12. Checklist Callout. Deleted.**8-13. BEFORE EXTERIOR CHECK.**

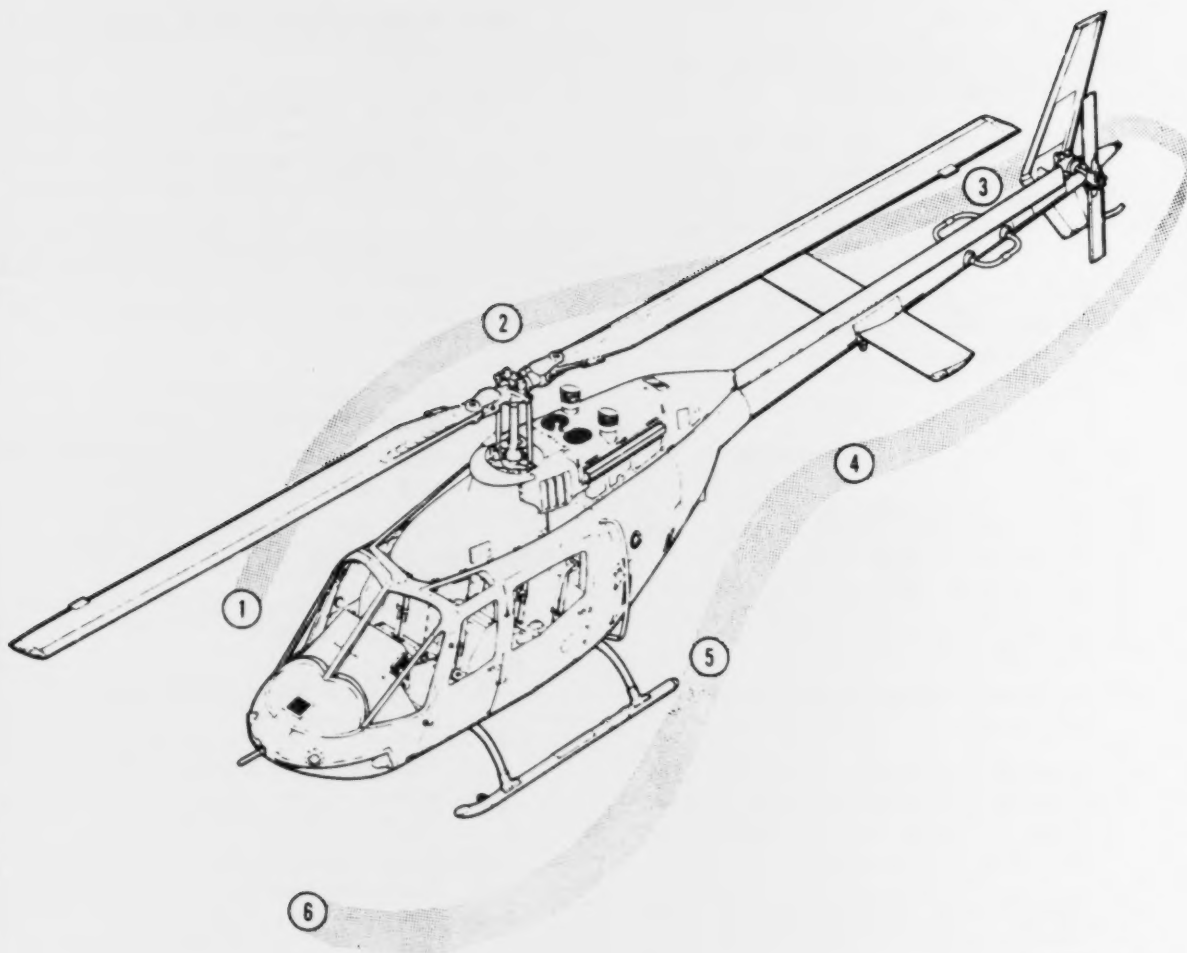
- *1. Publications — Check DA Forms 2408-12, -13, -14, and -18; DD Form 1896; DD Form

365F locally required forms and publications; and availability of Operators Manual (-10), and Checklist (-CL).

- *2. Ignition lock switch — ON.
- (0)*3. Helicopter door locks, covers, tiedowns, (except main rotor) and grounding cables — Removed and secured.
- (0)4. FUEL BOOST switch — OFF.
- 5. BAT switch — BAT.
- 6. NON-ESS BUS switch — MAN.
- 7. Fuel gage — Check quantity.
- 8. Lights — ON; check landing, anticollision, position and interior lights for condition and operation as required; then OFF.
- *8.1 Warning light segment - Check for illumination of the ROTOR RPM, MASTER CAUTION, ENGINE OUT, and XMSN OIL PRESS, warning lights. Press to test to check for illumination of XMSN OIL HOT light. Do not fly the helicopter if any of the lights fail to illuminate.
- (0) 9. NVG lights—Check NVG position, landing and searchlights if use is anticipated.
- 10. BAT switch — OFF.
- 11. Pilot seat, seat belt, shoulder harness, and armor side panels — Check condition and security.

8-14. EXTERIOR CHECK.**8-15. AREA 1 — FUSELAGE — CABIN RIGHT SIDE.**

- 1. Static port — Check unobstructed.
- (0)2. Pilot door — Check condition, operation and security.
- 3. Landing gear — Check condition and security of cross tubes, skid, and skid shoe. Handling wheel removed.
- (0)*4. Cargo — Check as required for proper loading installation and tiedown.



206900-249

Figure 8-2. Exterior check diagram

- (0)*4.1. Auxiliary fuel cell - Check condition, security, and fuel level cap secure.
- *5. Passenger seats and belts.
 - a. Check seat and back cushions for condition and security. Ensure seat belts are through loops on seat and back cushions and secured with nylon cord safety ties.
 - b. Check tabs on top of seat back for condition and security.
 - c. Check seat belts and shoulder harness for condition and security. Ensure shoulder harness and belts are properly fastened together (refer to fig. 2-10) and tightened.
 - d. If seat belts are not installed, seat and back cushions must be removed from helicopter prior to flight with doors off.
- 6. First aid kit - Check condition and security.
- 7. Fire extinguisher - Check for charge (seal not broken) date and security.
- 8. Inertia reel - Check for condition and installation of safety.
- 9. Cabin door - Check condition, operation, and security.
- *10. Hydraulic reservoir, servos and flight controls - Check for condition, security, leaks, and fluid level. Hydraulic filter buttons down; door secure.
- *11. Transmission compartment - Check condition, security, and oil level; condition of isolation mount boot cover; door secure.
- 12. Engine inlet and plenum - Check clean and unobstructed.
- *13. Fuel - Check quantity on first flight of the day and when refueled. Cap secure.
- 14. FM homing antenna - Check condition and security.

- (0) 15. NVG position lights - Check condition and security.
- 16. Fuselage - Check condition as other items are checked.
- 17. Drain lines and vents - Check condition and unobstructed.
- 18. Engine exhaust - Check condition and security.
- 19. Engine compartment - Check general condition; lines, cables, and connections for condition, security, and leaks; generator air intake unobstructed; door secure.
- 20. Transmission and engine cowling - Check secure.
- 21. Engine oil tank - Check condition, cap secure; secure door.
- 22. Lower anticollision light - Check condition and security.
- 23. WSPS Upper Cutter - Check condition and security.

8-16. AREA 2 - TAILBOOM - RIGHT SIDE.

- 1. Tailboom - Check condition as other items are checked.
- 2. Tail rotor driveshaft cover - Check condition and security.
- 3. Tail rotor drive shaft (if cover not installed). Check shaft, bearings and hangars for condition and security.
- 4. Horizontal stabilizer - Check condition and security.
- 5. Position light - Check condition and security.
- 6. Deleted.
- 7. VOR antenna - Check condition and security.

- *8. Main rotor blade - Check condition, rotate in normal direction 90° to fuselage, tie-down removed and secured.
- 9. Vertical fin - Check condition and security. Antenna connections secure.
- 10. Tailskid - Check condition and security
- 11. Position light - Check condition and security.
- (0) 12. NVG position lights - Check condition and security.
- *13. Tail rotor gear box - Check general condition, oil level, filler cap secure, and chip detector wire secure.

8-17. AREA 3 - TAILBOOM - LEFT SIDE.

- *1. Tail rotor - Check condition and security. Check both tail rotor blades for cracks on both sides in a area 6 to 7 inches from the butt end and approximately 5/8 to 2 inches aft of the leading edge.
- 2. VOR antenna - Check condition and security.
- 3. Tail rotor driveshaft cover - Check.
- 4. Tail rotor drive shaft (if cover not installed). Check shaft, bearings and hangars for conditions and security.
- 5. Tailboom - Check condition as other items are checked.
- 6. Horizontal stabilizer - Check condition and security.
- 7. Position light - Check condition and security.

8-18. AREA 4 - AFT FUSELAGE - LEFT SIDE.

- 1. Fuselage - Check condition as other items are checked.
- 2. Oil tank compartment - Check condition and security of oil cooler, driveshaft, and oil lines. Secure door.
- *3. Oil level - Check.
- 4. Avionics compartment - Check condition and security of components; secure door.
- 5. Engine compartment - Check general conditions; lines cables and connections for condition, security, and leaks; door secure.

- 6. Engine exhaust - Check. Secure.
- 7. Heater vent - Check unobstructed.
- (0) 8. NVG position lights - Check condition and security.
- 9. FM homing antenna - Check condition and security.
- 10. Transmission compartment - Check condition and security; secure door.
- *11. Main rotor blade - Check condition.
- 12. Engine inlet and plenum - Check clean and unobstructed.

8-19. AREA 5 - FUSELAGE - CABIN LEFT SIDE.

- 1. Engine oil cooler exhaust - check unobstructed.
- 2. Engine exhausts - Check unobstructed.
- 3. Anticollision light - Check condition and security.
- 4. Hydraulic reservoir - Check cap secure.
- 5. Transmission oil filler - Check cap secure.
- 6. Transmission oil cooler exhaust - Check unobstructed.
- *7. Main rotor system - Check condition and security. check level of fluid in grip and pillow block reservoirs, (if installed).
- 8. Hydraulic servos and flight controls - Check condition, operation and security.
- 9. Cowling - Check secure.
- 10. Inertia reel - Check for condition and security.
- *11. Passenger and seats and belts, check as follows:

- a. Check seat and back cushions for condition and security. Ensure seat belts are through loops on seat and back cushions and secured with nylon cord safety ties.
 - b. Check tabs on top of seat back for condition and security.
 - c. Check seat belts and shoulder harnesses for condition and security. Ensure shoulder harnesses and belts are properly fastened together and tightened.
 - d. If seat belts are not installed, seat and back cushions must be removed from helicopter prior to flight with doors off.
- *12. Loose equipment — Secure rotor blade tie-down, pitot tube cover, inlet and exhaust covers, and other equipment.
 - 13. Deleted.
 - (0)14. Cabin door — Check condition, operation, and security.
 - 15. Landing gear — Check condition and security of cross tubes, skid, and skid shoe.
 - *16. Fuel sample — Check for contamination before first flight of the day. If the fuel sump has not been drained by maintenance personnel, drain a sample and check.
 - 17. Copilot seat, seat belt, shoulder harness and armor side panels (if installed). Check condition and security. Secure seat belt and shoulder harness if the seat is not used.
 - 18. Deleted.
 - 19. Cyclic stick — Check securely installed; should be stowed if copilot seat is used by passenger; cannon plug connected.
 - 20. Collective — Check securely installed; should be stowed if copilot seat is used by passenger.
 - 21. Copilot door — Check condition, operation and security.
 - 22. Static port — Check unobstructed.

8-20. AREA 6 - FUSELAGE - FRONT.

- 1. Windshield - Check condition.

- 2. Ram air grill - Check unobstructed.
- 3. Pitot tube - Check unobstructed.

WARNING

Do not look into activated searchlight with IR lens installed; eyes may be permanent damaged.

- 4. Landing Searchlight - Check condition.
- 5. Fuselage underside - Check condition.
- (0) 6. WSPS Windshield Deflector-Check condition and security.
- (0) 7. WSPS Lower Cutter-Check condition and security.
- *8. Passenger Briefing - Complete as required. Refer to passenger briefing in Section VI.

8-21. BEFORE STARTING ENGINE.

- 1. Shoulder harness lock(s) - Check operation and leave unlocked.
- (0) 2. NVG filters-As Required.
- *3. Overhead switches and circuit breakers - Set as follows:
 - a. Cockpit utility light - As required.
 - b. Circuit breakers - In.
 - c. CONSOLE and INST LTS switches - As required.
 - *d. ANTI-COLLISION LTS switch - As required.
 - *e. POS LTS switch - As required; BRT for night; OFF for day.
- (0) f. NVG POS LTS switch - As required.
- g. AUTO ENG OIL switch - OFF. In a combat situation with the possibility of oil cooler damage, the switch should be at AUTO.
- h. HTR switch - OFF.
- i. DE-FOG and VENT switch - OFF.

- j. PITOT HTR switch - OFF.
- k. ENG DE-ICE switch - OFF.
- l. INV switch - OFF.
- m. NON-ESS BUS switch - MAN.
- n. GEN switch - OFF.
- *o. BAT switch - As required. Bat for battery start; OFF for GPU start.
- p. AUX RECP switch - OFF.
- q. Fuel valve handle - Check ON (Forward).

*4. GPU - Connect for GPU start.

5. Avionics - OFF, set as required.

*6. Instrument panel instruments and switches
Check and set as follows:

a. Systems instruments - Check engine instruments for static indications, slippage marks, and operating range limit markings.

b. Flight instruments - Check indications and set as follows:

(1) Airspeed indicator - Check indication, slippage mark and range limit markings.

(2) Attitude indicator - Check OFF flag visible.

(3) Vertical speed indicator - Check indication.

(4) Radio bearing heading indicator - Check OFF flag visible.

(5) Turn and slip indicator - Check race full of fluid.

(6) Magnetic compass - Check full of fluid.

c. Press to test lights - Check.

d. DIR GYRO/MAG switch - MAG.

e. FORCE TRIM switch - FORCE TRIM.

f. HYD BOOST switch - HYD BOOST.

*g. FUEL BOOST switch - FUEL BOOST.

7. CAUTION lights - Test; check illumination of CAUTION lights; reset.

*8. Flight controls - Check and set as follows:

a. Control frictions - Off.

b. Flight controls - Check for full travel. Center cyclic and pedals. Check engine out/low rotor audio by raising collective until audio is heard in headset then down. Collective pitch unobstructed and down.

c. Throttle - Check. Move to open, then to idle stop; press idle release and close.

9. Altimeter - Set to field elevation.

8-22. STARTING ENGINE.

*1. Fireguard - Posted.

*2. Rotor blades - Check clear and untied.

★ *3. Engine - Start as follows:

a. TOT - Check below 200°C.

b. Starter switch - Press and hold.

c. Throttle - Open to engine idle at peak of N1 RPM, provided the following limits are maintained.

FAT	MINIMUM N1
(1) 7°C and above	15% N1
(2) 7°C thru -18°C	13% N1
(3) -18°C and below	12% N1

d. Engine oil pressure - Check for increase by 20% N1.

e. Main rotor - Check moving by 30% N1.

f. TOT - Monitor for over-temperature conditions. Refer to figure 5-1 for limitations.

g. Starter switch - Release at 58-62% N1.

h. Engine oil pressure - Check.

i. XMSN OIL PRESS warning light - Check out.

j. N1 - 62-63%.

- *4. GPU - Disconnect.
- *5. BAT switch - BAT.
- *6. GEN switch - GEN.
- *7. NON-ESS BUS switch - As required.

CAUTION

Limit cyclic control movements to two inches maximum displacement.

8. Flight controls - Check as follows:

- a. FORCE trim switch - OFF.
- b. Check cyclic, collective and pedals for freedom of movement; tip path for correlation with cyclic movement.

CAUTION

With the Hydraulic switch OFF, both hands must be on the controls before any movement is made.

- c. HYD BOOST switch - OFF. The HYD PRESS caution light should illuminate and control pressure increase.
- d. Cyclic - Check for freedom of movement by moving the cyclic 45° right forward, then back to neutral. Feedback will be felt when moving the cyclic stick. If hydraulic servos are functioning properly, negligible force will be required to maintain a given stick position once stick is stopped by the pilot.
- e. Collective - Check freedom of movement by raising to observe a decrease in engine/rotor rpm and then move to the full down position.
- f. HYD BOOST switch - HYD BOOST. The HYD PRESS caution light should be out. Flight control pressures should be normal.
- g. FORCE TRIM switch - FORCE TRIM.

- *9. DC Amps - Check indication. DC amps must indicate 60 or less before the inverter is turned on.

- *10. INV switch - INV.
- *11. Avionics - On as required.

8-23. ENGINE RUNUP.

- *1. Engine and transmission instruments Check.
- *2. Throttle - Slowly increase to full open. Set N2 at 100% as required.
- 3. Deceleration check - Perform (if required) as follows:
 - a. Collective - DOWN.
 - b. Gen switch - OFF.
 - c. N2 RPM - 100% stabilize for at least 15 seconds.
 - d. Throttle - Idle. Simultaneously start a time count.
 - e. Stop time as N1 passes through 65%.

NOTE

Practice and/or retakes may be required before proficiency is obtained in timing the deceleration.

- f. Check deceleration time. Minimum allowable time is 2 seconds. If deceleration time is less than 2 seconds, make two checks to confirm the time.
- g. If deceleration time is less than 2 seconds, aircraft will not be flown until corrective action is accomplished. Refer to TM 55-2840-241-241-23.
- h. Gen switch - GEN.
- 4. ENG DE-ICE - Check by moving the switch to ENG DE-ICE; check for a rise in TOT; then OFF. TOT should decrease.
- 5. PITOT HTR - Check if use is anticipated by moving the switch to PITOT HTR; check for an increase in DC amps; then off.
- 6. DEFOG and VENT - Check if use is anticipated by moving the switch to DEFOG and VENT; check for an increase in DC amps; then off.

7. HTR - Check if use is anticipated by moving the switch to HTR; check for increase in TOT. Set switch as required.

8. Avionics - Check and set as required.

9. Flight instruments - Check and set as follows:

- a. Attitude indicator - Set.
- b. Altimeter - Set the current barometric pressure in Hg and compare altitude with field elevation.
- c. Heading indicators - Check that the heading indicator is aligned and corresponds with the magnetic compass. Set heading indicator as required.

*10. Doors, armor side panels, and seat belts (inside helicopter) - Secured.

11. Health indicator test (HIT) check - Refer to HIT TOT log in the helicopter log book. Perform before first flight of the day.

8-24. Takeoff to Hover.

EMERGENCY PROCEDURES — Paragraphs 9-17, 9-25

With the cyclic control in a neutral position, increase collective pitch with a smooth, positive pressure until the desired hovering altitude is reached. Apply tail rotor pedal pressures to maintain heading as collective pitch control is increased. As the helicopter leaves the ground, make minor corrections with cyclic control to ensure a vertical ascent and apply pedal pressures as necessary to maintain directional control. As the desired hover height is reached, adjust the flight controls as necessary to stabilize the helicopter at that height.

8-25. Hovering Turns.

Apply pressure on the desired pedal to begin the turn, using pressure and counterpressure on pedals as necessary to maintain constant rate of turn. Coordinate cyclic control to maintain the desired position over the selected pivot point while maintaining altitude with collective pitch control.

8-26. Sideward and Rearward Hovering Flight.

From a stabilized hover, apply cyclic control pressure in the desired direction of flight to begin sideward or rearward movement. Maintain the desired heading with pedals and altitude with collective pitch. To return to a stationary hover, apply cyclic pressure opposite the direction of movement while coordinating collective pitch and pedals to maintain the desired altitude and heading.

8-27. Hover/Taxi.

From a stabilized hover, apply forward cyclic pressure to begin forward movement. Maintain the desired heading with pedals and altitude with collective pitch. Changes in direction should be made primarily with pedal control to avoid excessive bank angles. To stop the forward movement, apply aft cyclic pressure while coordinating collective pitch and pedals to maintain the desired altitude and heading.

*8-28. HOVER CHECK.

Perform the following checks at a hover:

1. Flight controls — Check flight controls for correct response.
2. Engine and transmission instruments — Check.
3. Flight instruments — Check as required.
 - a. Vertical speed and altimeter — Check for indications of climb and descent.
 - b. Turn needle, heading indicator, and magnetic compass — Check for turn indications left and right.
 - c. Attitude indicator — Check for indications; nose high and low and banks left and right. Ball free in the race.
 - d. Airspeed indicator — Check indication.
4. Power — Check. The power check will determine if sufficient power is available for takeoff and is performed by comparing the torque required to hover at 4 feet with the predicted values from performance charts in Chapter 7.

*8-29. BEFORE TAKEOFF.

Immediately prior to takeoff, the following checks shall be accomplished:

1. N2 — 100%
2. Systems — Check engine, transmission, electrical, and fuel systems indications.

CAUTION

Seat belts and shoulder harness must also be properly fastened and tightened when seats are not occupied.

3. Crew, passengers and seat belts — Check.

4. Avionics - As required.

8-30. Deleted.

EMERGENCY PROCEDURES — Paragraph 9-12

8-31. Normal.

a. Align the helicopter with the desired takeoff course at a stabilized hover of approximately 3 feet (skid height) or an altitude permitting safe obstacle and terrain clearance. Smoothly apply forward cyclic pressure to begin acceleration into effective translational lift. As the helicopter begins its forward movement, additional collective pitch will be required to maintain altitude. Simultaneously adjust pedal pressure as necessary to maintain the desired heading. Control rate of acceleration and direction of flight with cyclic and altitude with collective. Continue to accelerate at the required altitude until effective translational lift has been attained, then begin a climb. Establish climb at the desired rate and airspeed. Continuous coordinated application of control pressures is necessary to maintain trim, heading, flight path, airspeed, rate of climb.

b. Refer to the height-velocity diagram Figure 5-6 for avoid areas. The height-velocity diagram assumes the availability of a suitable landing area in the event of engine failure. Since suitable landing areas are often times not available, operating outside the avoid areas during takeoff and climb will provide the highest margin of safety. Additionally, autorotational landings can be made at minimum sink rate and low or zero forward speed, thereby, minimizing damage and injuries, regardless of terrain.

c. A normal takeoff may be made from the ground by aligning the helicopter with the desired takeoff course on the ground and positioning the cyclic control slightly forward of neutral. Smoothly increase collective pitch to begin a climb to an altitude of approximately three feet, (or an altitude permitting safe obstacle and terrain clearance) while simultaneously accelerating the helicopter. Continue takeoff as above.

8-32. Maximum Performance.

EMERGENCY PROCEDURES — Paragraphs 9-11, 9-12

CAUTION

During take-off with the helicopter skids close to the ground, nose low attitudes of 10° or more can result in ground contact of the WSPS lower cutter tip. Forward c.g., high gross weight, high density altitude, transitional lift settling, and a tail wind increases the probability of ground contact.

a. A takeoff that demands maximum performance from the helicopter is necessary because of various combinations of heavy helicopter loads, restricted performance due to high density altitudes, barriers that must be cleared and other terrain features. The decision to use either of the following takeoff techniques must be based on an evaluation of the conditions and helicopter performance.

b. *Coordinated Climb.* Align the helicopter with the desired takeoff course at a stabilized hover of approximately 3 feet (skid height). Apply forward cyclic pressure smoothly and gradually while simultaneously increasing collective pitch to begin a coordinated acceleration and climb. Adjust pedal pressure as necessary to maintain the desired heading. Maximum torque available should be applied (without exceeding helicopter limits) as the helicopter attitude is established that will permit safe obstacle clearance. The climbout is continued at that attitude and power setting until the obstacle is cleared. After the obstacle is cleared, adjust helicopter attitude and collective pitch as required to establish a climb at the desired rate and airspeed. Continuous coordinated application of control pressures is necessary to maintain trim, heading, flight path, airspeed, and rate of climb. Takeoff may be made from the ground by positioning the cyclic control slightly forward of neutral prior to increasing collective pitch.

c. *Level - Acceleration.* Align the helicopter with the desired takeoff course at a stabilized hover of approximately 3 feet (skid height). Apply forward cyclic pressure smoothly and gradually while simultaneously increasing collective pitch to begin an acceleration at approximately 3 to 5 feet skid height. Adjust pedal pressure as necessary to maintain the desired heading. Maximum torque available should be applied (without exceeding aircraft limits) prior to accelerating through effective translational lift. Additional forward cyclic pressure will be necessary to allow for level acceleration to the desired climb airspeed. Approximately 5 knots prior to reaching the desired climb airspeed, gradually reduce forward cyclic pressure and allow the aircraft to begin a constant airspeed climb to clear the obstacle. Care must be taken not to decrease airspeed during the climbout since this may result in the helicopter descending (falling through). After the obstacle is cleared adjust helicopter attitude and collective pitch as required to establish a climb at the desired rate and airspeed. Continuous coordinated application of control pressures is necessary to maintain trim, heading, flight path, airspeed, and rate of climb. Takeoff may be made from the ground by positioning the cyclic control slightly forward of neutral prior to increasing collective pitch.

d. Power Application.**CAUTION**

Do not exceed helicopter limits during power application.

The copilot (when available) can assist the pilot in maintaining proper rpm by calling out rpm and torque as power changes are made, thereby allowing the pilot more attention outside the cockpit.

e. Comparison of Techniques. Where the two techniques yield the same distance over a fifty-foot obstacle, the coordinated climb technique will give a shorter distance over lower obstacles and the level acceleration technique will give a shorter distance over obstacles higher than fifty feet. The two techniques give approximately the same distance over a fifty-foot obstacle when the helicopter can barely hover OGE. As hover capability is decreased the level acceleration technique gives increasingly shorter distances than the coordinated climb technique. In addition to the distance comparison, the main advantages of the level acceleration technique are: (1) It requires less or no time in the avoid area of the height velocity diagram; (2) performance is more repeatable since reference to attitudes which change with loading and airspeed is not required; (3) at the higher climb-out airspeeds (30 knots or more), reliable indicated airspeeds are available for accurate airspeed reference from the beginning of the climbout, therefore minimizing the possibility of fall through. The main advantage of the coordinated climb technique is that the climb angle is established early in the takeoff and more distance and time are available to abort the takeoff if the obstacle cannot be cleared.

8-33. Crosswind Takeoff.

A crosswind takeoff does not require a significantly different technique than a takeoff into the wind. The primary difference is the requirement to hold the cyclic into the wind to prevent drift. For right crosswinds additional power is required because of more left pedal being applied to maintain the desired heading.

8-34. Climb.

After takeoff, select the airspeed necessary to clear obstacles. When obstacles are cleared, adjust the airspeed as desired at or above the maximum rate of climb airspeed. Refer to Chapter 7 for recommended airspeeds.

8-35. Cruise.

When the desired cruise altitude is reached, adjust power as necessary to maintain the required airspeed. Refer to Chapter 7 for recommended airspeeds, power settings, and fuel flow.

8-36. Descent.**EMERGENCY PROCEDURES — Paragraphs 9-8, 9-11**

Adjust power and attitude as necessary to attain and maintain the desired airspeed and rate during descent. Refer to Chapter 7 for power requirements at selected airspeeds and rates of descent. All checks of mission equipment that must be made in preparation for landing should be accomplished during descent.

8-37. BEFORE LANDING.

Prior to landing, the following checks shall be accomplished.

1. Crew and passengers - Check.
2. Landing/searchlight - As required.

8-38. Landing.**EMERGENCY PROCEDURES — Paragraphs 9-8, 9-11****8-39. Normal Approach.**

The approach begins by adjusting power and attitude as required to establish an approach angle of approximately 8 to 10 degrees at an airspeed above the minimum rate of descent airspeed specified in Chapter 7. Maintain the entry airspeed until the apparent ground speed and rate of closure appear to increase. From this point, progressively decrease rate of descent and forward speed to stop all forward movement at an approximate 3-foot hover (or continue to the ground). As forward speed decreases below effective translational lift it will be necessary to gradually and smoothly increase collective pitch to terminate the approach. Refer to Chapter 7 for airspeeds, rates of descent and power requirements. Refer to the Height Velocity Diagram, Figure 5-6, for avoid areas during the approach.

8-40. Steep Approach.

A steep approach is used as necessary to clear obstacles in the approach path. It is executed in the same manner as the normal approach except for the slower airspeeds that must be maintained throughout the approach. Approach angles may vary from above a normal approach to a vertical descent. Because of the increased power requirements during termination, smooth and gradual collective pitch movements are very important.

8-41. Shallow Approach.

A shallow approach is used as necessary when instrument, tactical, or emergency requirements make it necessary to execute an approach at an angle less than that of a normal approach. It is executed in the same manner as a normal approach except that deceleration may be more rapid. Approach angles may vary from below a normal approach to approximately zero.

8-42. Running Landing.

A running landing is used for some flight control malfunctions. The approach is shallow and flown at an airspeed that provides safe aircraft control. Airspeed is maintained as for a normal approach except that touchdown is made at an airspeed above effective translational lift. After ground contact is made, slowly decrease collective pitch to minimize forward speed. If braking action is necessary, the collective pitch may be lowered as required for quicker stopping.

8-43. Landing From a Hover.**EMERGENCY PROCEDURES — Paragraph 9-25**

From a stabilized hover, decrease collective pitch control to begin a gradual descent to touchdown, making necessary corrections with pedals and cyclic control to prevent movement over the ground. Upon contact with the ground, continue to decrease collective pitch control smoothly and steadily until the entire weight of the helicopter is on the ground. Apply cyclic control as necessary to level rotor system.

8-44. AFTER LANDING.

1. Landing/searchlight - As required.
2. Transponder - As required.

8-45. ENGINE SHUTDOWN.

1. Collective - Down.

CAUTION

If throttle is inadvertently rolled to the off position, do not attempt to roll it back on. Perform a hot start emergency shutdown if it appears that TOT limits will be exceeded.

2. Throttle - Reduce to engine idle. Allow TOT to stabilize for two minutes. Check N1 speed 62 to 63%.
3. FORCE TRIM switch - FORCE TRIM.
4. FUEL BOOST switch - OFF.
5. Control frictions - On.
6. Avionics - OFF.
7. Overhead switches and circuit breakers - Set as follows:
 - a. AUTO ENG OIL switch - OFF.
 - b. HTR switch - OFF.
 - c. DE-FOG and VENT switch - OFF.
 - d. ENG DE-ICE switch - OFF.
 - e. INV switch - OFF.
 - f. NON-ESS BUS switch - MAN.
8. BATTERY CHARGE - Check as follows:
 - a. BAT switch - OFF.
 - b. AMMETER - Check change in indication. If the change in indication is less than 5.0 amperes, the battery is fully charged.
 - c. BAT switch - BAT.
9. Throttle - OFF. TOT should be stabilized below 400°C. If TOT rises above 400°C, press the starter switch with the throttle closed until TOT is less than 200°C.

10. Overhead switches - OFF as follows (after rotor has stopped).

- a. Console and INST LTS.
- b. Anti-collision LTS.
- c. POS LTS.
- d. NVG POS LTS.
- e. GEN.
- f. BAT.

11. Ignition lock switch - OFF. (Remove key as required.)

CAUTION

Do not drop seat belt against side of aircraft. Buckles and bracket will damage honeycomb panel under crewmember door frame.

(0) 12. Doors - Close immediately after exiting aircraft.

8-46. BEFORE LEAVING HELICOPTER.

- 1. Main rotor blades - Tie down.
- 2. Walk around inspection - Complete an inspection of the helicopter checking for damage, leaks, and fluid levels as required.
- 3. Mission equipment - Secure.
- 4. Complete DA Forms 2406-12 and -13.
- 5. Secure helicopter.

Section III. INSTRUMENT FLIGHT

8-47. Instrument Flight — General.

This helicopter is restricted to visual flight conditions. Flight into instrument meteorological conditions will be conducted on an emergency basis only. Flight handling, stability characteristics, and range are the same during instrument flight as for visual flight. Navigation and communication equipment are adequate for instrument flight.

8-48. Instrument Flight Procedures.

The procedures in this section are applicable for flights in visual conditions or if the helicopter is inadvertently flown into instrument meteorological conditions. Refer to FM 1-5, FM 1-30, FLIP, AR 95-1, FAR Part 91, and procedures described in this manual.

8-49. Instrument Takeoff.

Complete the normal checks prescribed in this chapter, to include a power check. An instrument takeoff should not be attempted with less than a hover out-of-ground effect capability. When ready for takeoff, align the helicopter with the takeoff course. Set the Attitude Indicator Miniature Aircraft five (5) degrees above horizon resulting in miniature aircraft level at 80 KTS, IAS. Using outside references to prevent movement of the helicopter, increase collective pitch sufficiently to get the helicopter light on the ground. Then while referring to the helicopter instruments, continue to increase collective pitch smoothly and steadily until takeoff power is reached. Gradually adjust helicopter attitude to place the attitude indicator miniature aircraft one bar-widths below the horizon, while maintaining a wings-level attitude. As the desired climb airspeed is reached, adjust helicopter attitude and power to maintain the desired airspeed and recommended rate of climb.

8-50. Instrument Climb.

Refer to Chapter 7 for airspeeds, power required, rates-of-climb and fuel consumption.

8-51. Instrument Cruise.

There are no unusual flight characteristics during cruise in IMC.

8-52. Speed Range.

Stability and flight characteristics are normal from maximum rate of climb airspeed through the full speed range during instrument flight. Power settings during instrument flight should be in accordance with the cruise charts in Chapter 7.

8-53. Communication and Navigation Equipment.

No special technique in the use of avionics is required for instrument flight.

8-54. Instrument Descent.

Normally, descent will be made at cruise speed by reducing power as required. When a descent at slower than cruise speed is desired, slow the aircraft to the desired speed before initiating the descent. Refer to Chapter 7 for airspeeds, power required, rates of descent and fuel consumption.

8-55. Holding.

When holding enroute, it may be accomplished at cruise speed. Refer to Chapter 7 for airspeed, power required, and fuel consumption.

8-56. Instrument Approaches.

Instrument approaches may be accomplished at cruise speeds. Refer to Chapter 7 for airspeed, power required, and fuel consumption. The helicopter may be decelerated during the approach, but should not be flown at airspeeds below 60 KIAS while in instrument flight conditions.

8-57. Night Flying.

Before takeoff, it is imperative to ensure that all lights, instruments, and avionics equipment are functioning perfectly; especially when using night vision goggles. Generally, interior lighting should be kept to the minimum amount which will still allow complete visibility of all instruments and gages. Excessive cockpit lighting decreases outside visibility. Avoid using landing lights when in thick haze, dust, snow, smoke, or fog, as reflected light will reduce visibility and may affect depth perception. During ground operations, the helicopter should be hovered/taxied slowly, because it is difficult to judge actual ground speed and excessive speeds may be developed without realizing it.

Section IV. FLIGHT CHARACTERISTICS

8-58. Operating Characteristics.

a. The flight characteristics of this helicopter in general, are similar to other single rotor helicopters.

b. N2 droop may occur during a normal flight maneuver requiring a rapid increase in power (i.e., rapid collective and/or tail rotor inputs, high G turns, steep turns). If N2 droop occurs, but low RPM warning is not activated and N2 recovers to 100 percent within five (5) seconds, and further droop is not experienced, this is considered a normal flight characteristic.

8-59. Rotor Blade Stall.

Rotor blade stall is not a characteristic of the helicopter. The power limits and VNE limits will be reached prior to a blade stall.

8-60. Rollover Characteristics.

During normal or slope takeoffs and landings with some bank angle or side drift with one skid on the ground, the bank angle or side drift can cause the helicopter to get into the situation where it is pivoting about a skid (figure 8-3). When this happens, lateral cyclic control response is more sluggish and less effective than for the free hovering helicopter. Consequently, if the bank angle (the angle between the helicopter and the horizon) is allowed to build up past 15°, the helicopter will enter a rolling maneuver that cannot be corrected with full cyclic and the helicopter will roll over on its side. In addition, as the roll rate and acceleration of the rolling motion increases, the angle at which recovery is still possible is significantly reduced. The critical rollover angle is also reduced for a right skid down condition, crosswinds, lateral center of gravity offset and left pedal inputs.

a. When performing maneuvers with one skid on the ground, care must be taken to keep the helicopter trimmed, especially laterally. For example, if slow takeoff is attempted and the tail rotor thrust contribution to rolling moment is not trimmed out with cyclic, the critical recovery angle will be exceeded in less than two (2) seconds. Control can be maintained if the pilot maintains trim, does not allow helicopter rates to become large, and keeps the bank angle from getting too large. The pilot must fly the helicopter into the air smoothly keeping excursions in pitch, roll and yaw low and not allowing any untrimmed moments.

b. When performing normal takeoffs and landings on relatively level ground with one skid on the ground and thrust (lift) approximately equal to

the weight, carefully maintain the helicopter position relative to the ground with the flight controls. Perform maneuvers smoothly and keep the helicopter trimmed so that no rates build up, especially roll rate. If the bank angle starts to increase to a large angle (5° to 8°) and full corrective cyclic does not reduce the angle, reduce collective to reduce the unstable rolling moment caused by the thrust (lift) vector.

c. When performing slop takeoff and landing maneuvers, follow the published procedures, being careful to keep roll rates small. Slowly raise the down slope skid to bring the helicopter level and then lift off. (If landing, land on one skid and slowly lower the down slope skid.) If the helicopter rolls to the up slope side (5° to 8°), reduce collective to correct the bank angle and return to level attitude and then start the takeoff procedure again.

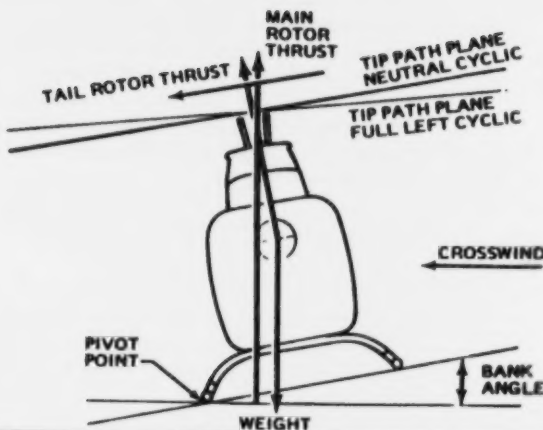
d. Collective is much more effective in controlling the rolling motion than lateral cyclic because it reduces the main rotor thrust. A smooth, moderate collective reduction of less than approximately 40% (at a rate less than approximately full up to full down in two (2) seconds) is adequate to stop the rolling motion with about two (2) degrees bank angle overshoot from where down collective is applied. Care must be taken to not dump collective at too high a rate as to cause fuselage-rotor blade contact. Additionally, if the helicopter is on a slope and the roll starts to the up slope side (figure 8-3), reducing collective too fast creates a high rate in the opposite direction. When the down slope skid hits the ground, the dynamics of the motion can cause the helicopter to roll about down-slope skid and over onto its side. Do not pull collective suddenly to get airborne as a large and abrupt rolling moment in the opposite direction will result (figure 8-3). This moment may be uncontrollable.

WARNING

If the helicopter reaches 15° of bank angle with one skid on the ground and thrust (lift) is approximately equal to the weight, the helicopter will roll over on its side.

CAUTION

When landing or taking off, with thrust (lift) approximately equal to the weight and one skid on the ground, keep the helicopter level and do not allow helicopter rates to build up. Fly the helicopter smoothly off

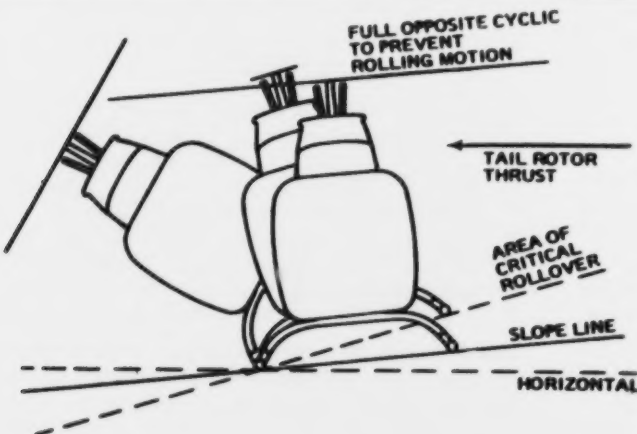
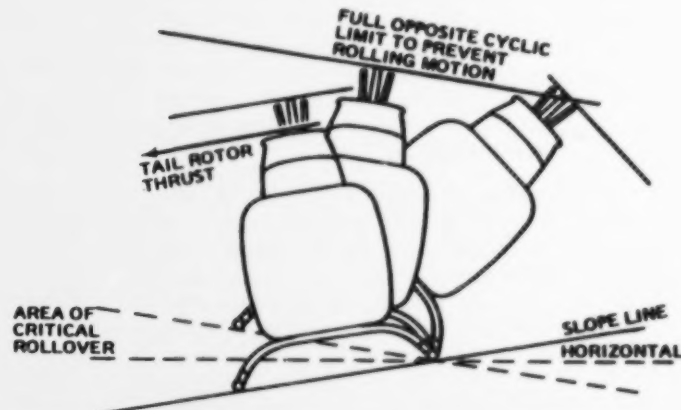


EXAMPLE OF FORCES ACTING ON A HELICOPTER WITH RIGHT SKID ON THE GROUND

During normal takeoffs to a hover and landings from a hover, cross slope takeoffs and landings, and takeoffs from the ground with bank angle or side drift, a situation can exist where the helicopter will pivot about the skid/wheel which remains on the ground and enter a rolling motion that cannot be corrected with full lateral cyclic input.

UPSLOPE ROLLING MOTION

Excessive application of cyclic into the slope, in coordination with collective pitch application. During landings or takeoffs, this condition results in the downslope skid rising sufficiently to exceed lateral cyclic control limits and an upslope rolling motion occurs.



DOWNSLOPE ROLLING MOTION

Excessive application of collective pitch in coordination with cyclic application into the slope. When the downslope skid is on the slope, excessive application of collective may result in the upslope skid rising sufficiently to exceed lateral cyclic limits and induce a downslope rolling motion.

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Figure 8-3. Forces acting on the helicopter.

(or onto) the ground, carefully maintaining trim.

8-61. Mast Bumping.

EMERGENCY PROCEDURES — Paragraph 9-28

Mast bumping (flapping-stop contact) is the main yoke contacting the mast and may result in a fractured mast and rotor separation. It may occur during slope landings, rotor startup/coastdown, or when the flight envelope is exceeded. If bumping occurs during a slope landing, reposition the cyclic to stop the bumping, and land on less sloping ground, reestablish a hover, if bumping occurs during startup or shutdown, move cyclic to minimize or eliminate bumping. If the flight envelope is inadvertently exceeded, causing a low "G" condition and right roll, move cyclic aft to return rotor to a positive thrust condition, then roll level, continuing flight if mast bumping has not occurred. As collective pitch is reduced after engine failure or loss of tail rotor thrust, cyclic must be positioned to maintain positive "G" forces during autorotation. Touchdown should be accomplished prior to excessive rotor RPM decay. After landing, an entry in DA Form 2408-13 is required for appropriate maintenance inspection.

8-61.1 PYLON WHIRL.

Pylon whirl is a condition which occurs after blade flapping and mast bumping. The resultant motion of the pylon is elliptical and contact of the adapter mount against its static stop is apt to occur. If the frequency of motion coincides with a particular natural frequency of the helicopter, and the amplitude and direction of the force is large enough, damaging vibrations can occur in the aft section-tailboom of the helicopter. Motion of this type could occur during touchdown autorotations if operational limits are exceeded.

8-61.2. CRITICAL TAILBOOM DYNAMIC MODES.

Two critical tailboom dynamic modes exist. One of these may occur during an improperly executed touchdown autorotational landing and corresponds to a frequency of less than 64% main rotor RPM. The second may occur during a high speed autorotational entry, a short final, or any

maneuver in which application of collective allows a significant decay in RPM down to a critical frequency corresponding to approximately 68-73% main rotor RPM. High forward speed relative to the maneuver may provide the driving force for excessive blade flapping, mast bumping, and as a result, damaging vibration. Likelihood of encountering the second mode is remote, and is avoidable if operating limitations of the helicopter are observed.

8-61.3. SPIKE KNOCK.

Spike-knock occurs when the round pin in the drag pin fitting strikes the side of the square hole of the pylon stop, which is mounted to roof. It creates a loud noise and will occur during a violent rocking of the pylon.

The following corrective action should be taken when spike-knock occurs.

PROBABLE CAUSE	CORRECTIVE ACTION
Low rotor RPM	Maintain proper rotor RPM.
Extreme asymmetric loading	Maintain lateral C.G. within allowable range.
Poor execution of autorotation landing	Execute proper autorotational landing procedure.
Low g maneuvers	Avoid flight at less than +0.5g.

CAUTION

If spike knock is encountered, an entry must be made in the DA Form 2408-13, Aircraft Inspection and Maintenance Record. The entry must include flight conditions under which spike knock occurred. An inspection shall be performed by maintenance personnel before continuing.

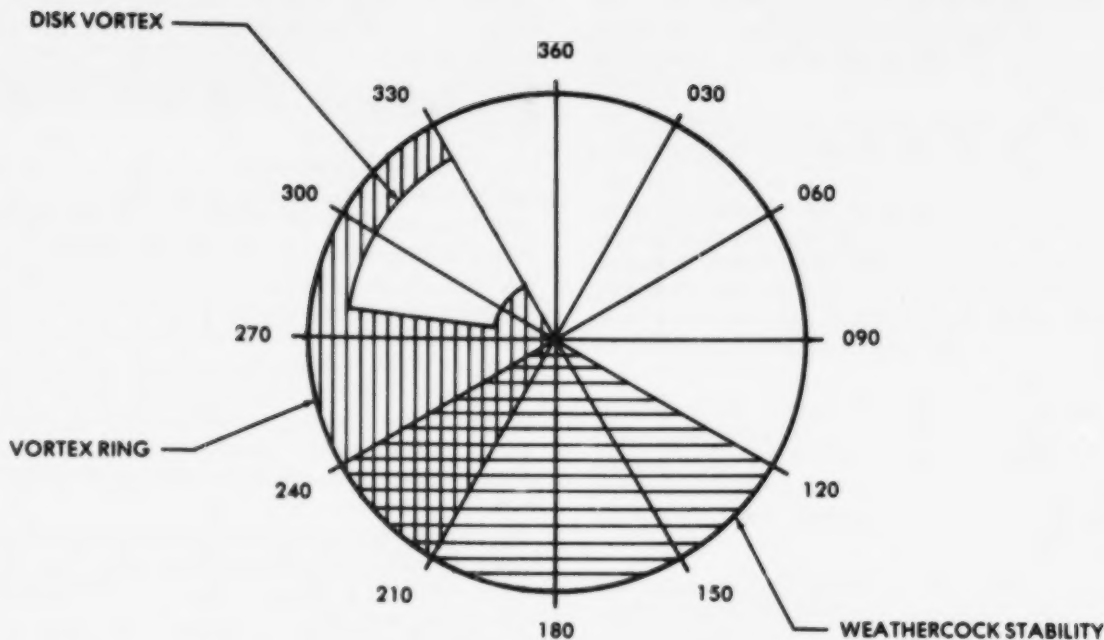


Figure 8-4. Effects of Wind Azimuth on Aircraft

8-61.4. Loss of Tail Rotor Effectiveness.

a. Loss of tail rotor effectiveness (LTE) is the occurrence of an uncommanded and rapid right yaw rate which does not subside of its own accord and which, if not quickly reacted to, can result in loss of aircraft control. However, the term "loss of tail rotor effectiveness" is misleading. The tail rotor on this aircraft has exhibited the capability to produce thrust during all flight regimes. Under varying combinations of wind azimuth and velocity, tail rotor thrust variations can occur. When this occurs, the helicopter will attempt to make a sudden quick yaw to the right. This yaw is usually correctable if immediate additional left pedal is applied. Correct and timely pilot response to an uncommanded right yaw is critical. If the response is incorrect or slow, the yaw rate may rapidly increase to a point where recovery may not be possible in the terrain flight regime. The pilot must anticipate these variations, concentrate on flying the aircraft, and not allow a yaw rate to build.

b. Extensive flight testing and wind tunnel tests have identified three relative wind azimuth regions as capable of adversely affecting aircraft controllability and dramatically increasing pilot workload. Although specific wind azimuths are identified for each region, the pilot must realize the azimuths may shift depending on the ambient conditions. See Figure 8-4.

(1) Weathercock Stability (120-240 degrees). Winds within this region will attempt to weather-vane the aircraft into the relative wind. The helicopter exhibits a tendency to make a slow uncommanded yaw to either the left or right depending upon the exact wind direction. Due to the inherent yaw characteristics of this helicopter, the yaw rate will increase unless arrested by the pilot. A right yaw can develop into an LTE condition and requires immediate correction.

(2) Vortex Ring State (210-330 degrees). Winds within this region will cause a vortex ring state to develop around the tail rotor which, in turn, causes tail rotor thrust variations. The helicopter exhibits a tendency to make uncommanded pitch, roll and yaw excursions. The subsequent aircraft reactions require multiple pedal, cycle and collective inputs by the pilot. Maintaining a precise heading in this region will be impossible. Pilot workload in this region will be high, therefore, the pilot must concentrate fully on flying the aircraft and not allow a right yaw rate to build.

(3) Disc Vortex (280-330 degrees). Winds within this region will cause the main rotor tip vortices to be directed onto the tail rotor. The effect of this main rotor vortex is to cause the tail rotor to operate in an extremely turbulent environment. The helicopter will exhibit a tendency to make a

sudden uncommanded right yaw which, if uncorrected, will develop into a spin. When operating in this region, the pilot must anticipate the sudden demand for left pedal inputs.

c. Other factors which may be present can significantly influence the severity of the onset of LTE. These factors are:

(1) Gross weight and density altitude. An increase in either of these factors will decrease the power margin between the maximum available and power required to hover. The pilot should conduct a low level, low airspeed mission with only minimum essential personnel and equipment on board.

(2) Low indicated airspeed. At airspeeds below LTE, the tail rotor is required to produce nearly 100 percent of the directional control. If the required amount of tail rotor thrust is not available, for whatever reason, the aircraft will yaw to the right.

(3) Power droop. A rapid power application may cause a transient power droop to occur. Any decrease in main rotor RPM will cause a corresponding decrease in tail rotor thrust. The pilot must anticipate this and apply additional left pedal to counter the main rotor torque. All power demands should be made as smoothly as possible to minimize the effect of the power droop.

CAUTION

Low airspeed maneuvering flight at airspeeds below 35 knots are not recommended under conditions where the power required to hover out of ground effect exceeds the maximum continuous power.

d. The OH-58, in its typical mission configuration, is closer to its maximum gross weight than most other aircraft in the Army inventory; thus the pilot is consistently operating closer to power and directional control limits. For this reason, the aircraft heading should be kept into the wind as much as possible when operating at low indicated airspeeds. If this is not possible, it is very important that precise heading control be maintained to minimize the yaw excursions that could lead to LTE. Additionally, it has been determined that there is a greater susceptibility to LTE for right turns (especially right downwind turns at low altitude and low airspeeds) than for left turns. Therefore, pilots should exercise caution when executing right turns under conditions conducive to LTE.

8-61.5. Deleted.

8-61.6. OPERATION ROTOR NOISE CONDITIONS.

a. Two noises can be created by the rotor system and both are completely different; one would be a condition called Mast Bumping and the other would be a condition called Spike Knocking.

b. Spike knock can occur during landing and is the condition wherein the Drag Pin bottoms out or contacts the Transmission mount support. Normally the Pylon Isolation Mount, will prevent the drag pin (spike) from contacting the mount support, but a hard landing, a running landing, an improper landing and/or improper autorotation landing technique may result in the transient condition.

c. If the pylon mount is deteriorated there may occur an inflight condition called pylon rock but there would not be the metal-to-metal contact, spike knock condition.

d. There also could be an inflight condition called mast bumping. This condition lasts a very short duration (less than four cycles). The conditions which excite mast bumping are low rotor RPM (less than 320) and rapid longitudinal cyclic inputs (approx. one inch steps).

e. It is not likely that operational autorotational entries will result in mast bumping if the rotor RPM is not allowed to go below the minimum limit (93%).

f. Mast Bumping is characterized by unusual vibration in the airframe accompanied by sharp audible metal-to-metal contact. This condition can be avoided by not utilizing rapid cyclic inputs when the rotor RPM is below the minimum operating limits (The metal-to-metal noise is the static stop contacting the mast).

g. During spike knock conditions normally there may not be aircraft vibrations experienced if the condition is simple metal-to-metal contact of the spike with the adapter on the deck. There is a condition where spike with the adapter on the deck. There is a condition where spike knock occurs and vibrations will (or may occur) and this is discussed in the following paragraphs.

h. It should also be pointed out that spike knock in flight could occur but this would be the result of a violent aircraft maneuver which is one which is outside the flight manual limitations; corrective action would be prohibiting flight maneuvers outside flight manual limitations.

i. Spike knock will be more prevalent during zero ground roll auto-rotation landings; for running or sliding autorotation landings spike knock will be less prevalent. Some spike knock can be expected in student training during autorotation training, but as proper techniques are acquired then its occurrence is minimal. Spike knock in itself is not hazardous, but is an indicator of a condition which could be hazardous.

j. If during autorotation landings there is a combination of low rotor speeds and high collective blade angles this will result in excessive flapping of the main rotor; there will be contact of the hub against the flapping stops. There will also be excessive fore and aft (as well as possible lateral) excursions of the pylon.

k. At high blade angles of attack (increased collective) there may be a point in the autorotation where the blade does not produce more lift. This increased collective (increased blade angle) may induce rotor blade flapping, especially under high wind conditions.

l. Rotor blade flapping, with low rotor RPM, in power off autorotations is a condition where problems could occur. The rotor blade flap is the initiation of a cycle where damage could occur. The cycle would be as follows: rotor blade flap - causes/results in mast static stop to mast contact - results in spike knock which is drag pin contact with the mount - which causes main rotor inertia/energy transfer to the airframe - which ultimately results in the airframe responding to this energy.

m. When there is the improper condition of low rotor speed and high collective blade angles, there will be excessive flapping of the main rotor. This could also be aggravated by high winds and/or abrupt fore and aft cyclic inputs while in this condition. When the blades flap in this condition the static stop is contacted and the natural frequencies of the fore and aft pylon mode will be driven up.

n. At about 150 rpm, a 2/rev of the rotor will produce a forcing frequency and at high collective blade angles will also produce excessive blade flapping which will increase the natural frequencies of the fore and aft pylon.

o. As the collective angles build up to 100%, excessive blade flapping occurs which begins by the blade (hub) bottoming out on its stops and in turn the pylon bottoms out on its stops (spike knock) in both the fore and aft and also lateral directions. These conditions generate a resonant condition and (rapidly) the tail boom will respond to these

frequencies. The tail boom will then have (usually) up and down movements as it responds to the resonant condition and at some point a structural failure will occur.

p. Typically there will be wrinkles in the tail boom just aft of the boom attach point, but if the resonant conditions were large enough there could also be damage to the longerons in the aft fuselage. Further, subsequent inspections will show spike damage, mount damage, mount support damage and also upper cowl damage where the pylon whirling has caused cowl contact.

q. These 1/rev and 2/rev frequency points induce large loads into the tail boom, and test data shows under the aforementioned conditions there are magnification factors of 40/60 to 1. Thus a 10 lb input at the main rotor hub could produce a 400 to 600 psi load in the aft fuselage/tail boom area.

r. When the damaging spike knock conditions described above occur there should also be experienced (heard and felt) resulting airframe skin buckling and "oil-canning" especially in the right and left sides of the aft fuselage skin as well as oil canning of the deck below the transmission. The knock heard would be the spike contact, mast static stop contact, and also the pylon to cowl contact. There also should be felt in the pilot/co-pilots seats the airframe vibrations.

s. After the tail boom has buckled and/or been damaged, or there has been a failure in the aft fuselage the vibrations may (and usually will) cease; predominantly because the failure unloads the condition and/or the landing has stopped, or main rotor flapping has ceased. In any case, the aircraft must not be released for flight until the airframe has been inspected. Damage to the tail boom or aft fuselage may result in catastrophic inflight failure.

t. Spike knock could also occur after the engine is shut down and as the main rotor RPM is coasting down to a stop especially if there are high winds, and/or the elastomeric damper is deteriorated, but as can be gathered from the preceding this is not the same condition. The pilot may hear (or feel) the spike knock but he will not experience the balance of the other conditions; this type of spike knock is NOT what is damaging to the aircraft. Further, during starts or prior to starts with a deteriorated damper, and/or high winds these could be spike knock or mast contact but this is not what is described above.

Section V. ADVERSE ENVIRONMENTAL CONDITIONS

8-62. Cold Weather Operations. Operation of the helicopter in cold weather or an arctic environment presents no unusual problems if the operators are aware of those changes that do take place and conditions that may exist because of the lower temperatures and freezing moisture.

a. Inspection. The pilot must be more thorough in the walk-around inspection when temperatures have been at or below 0°C. (32°F.). Water and snow may have entered many parts during operations or in periods when the helicopter was parked unsheltered. This moisture often remains to form ice which will immobilize moving parts or damage structure by expansion and will occasionally foul electric circuitry.

Protection covers afford majority protection against rain, freezing rain, sleet, and snow when installed on a dry helicopter prior to precipitation. Since it is not practicable to completely cover an unsheltered helicopter, those parts not protected by covers and those adjacent to cover overlap and joints require closer attention, especially after a blowing snow or freezing rain. Accumulation of snow and ice should be removed prior to flight. Failure to do so can result in hazardous flight, due to aerodynamic and center of gravity disturbances as well as the introduction of snow, water, and ice into internal moving parts and electrical systems. The pilot should be particularly attentive to the main and tail rotor systems and their exposed control linkages.

b. Checks.

(1) Exterior check 0°C (32°F) to -54°C (-65°F). Perform exterior check as outlined in Section II, plus the following checks.

CAUTION

Check that all surfaces and controls are free of ice and snow.

NOTE

Contraction of the fluids in the helicopter system at extreme low temperature causes indication of low levels. A check made just after the previous shutdown and carried forward to the walk around check is satisfactory if no leaks are in evidence. Filling when the system is cold-soaked will reveal an over-full condition immediately after flight, with the possibility of forced leaks at seals.

(a) Main Rotor — Check free of ice, frost, and snow.

(b) Engine.

1 Inspect inlet for possible accumulations of snow, slush or ice. Accumulations must be removed from the interior of the reverse flow inlet (hand removal is acceptable).

2 Inspect the engine plenum chamber through the plexiglass windows (a flashlight may be required) on each side of the inlet cowling for snow, slush or ice, paying particular attention to the firewalls, rear face of the particle separator, bottom corners and protruding surfaces such as guide vanes, etc.

3 Visually inspect the plastic particle separator eductor tubes on each side of the engine fairing for obstructions and snow. A thin film of ice about the interior of each tube is acceptable. External ice adjacent to the eductor tubes is acceptable.

(2) Interior check — all flights 0°C (32°F) to -54°C (-65°F). Perform check as specified in Section II.

(3) Interior check — night flights 0°C (32°F) to -54°C (-65°F). External Power connected. Perform check as specified in Section II.

(4) Engine starting check — 0°C (32°F) to -54°C (-65°F). Perform check as outlined in Section II.

(5) Engine Anti-Ice: The engine de-ice switch should be on when flying in visible moisture at OAT 5°C (41°F) or below.

NOTE

During cold weather starting the engine oil pressure gage may exceed 130 psi. The engine should be warmed up at engine idle until the engine oil pressure indicator is below 130 psi.

(6) Engine runup check. Perform the check as outlined in Section II.

WARNING

Control system checks should be performed with extreme caution when helicopter is parked on snow and ice. There is reduction in ground friction holding the helicopter stationary, controls are sensitive and response is immediate.

c. Engine Starting Without External Power Supply. If a battery start must be attempted when the helicopter and battery have been cold-soaked at temperatures between -26°C to -37°C (-15°F to -34°F), preheat the engine and battery if equipment is available and time permits. Preheating will result in a faster starter cranking speed which tends to reduce the hot start hazard by assisting the engine to reach a self-sustaining speed.

8-63. Snow.

a. Takeoff. Snow takeoff may be considered normal except for the following precautions that should be observed.

(1) Loose or powdery snow will restrict visibility.

(2) Before attempting to takeoff make sure the landing gear skids are free and not frozen to the surface.

(3) Ground operation time should be minimized to reduce the possibility of engine air starvation due to snow and ice accumulation.

WARNING

When making an approach and landing on snow it should be one continuous operation without extended hover in order to reduce the white-out condition that results from extended hovering over snow. This white-out will usually occur on loose snow and can cause the pilot to lose all reference with the ground or any object he is approaching. If the object being used as reference should become completely obscured, accomplish a go-round.

b. Landing — Snow. Snow landing may be considered normal except for the following precautions that should be observed:

(1) If possible select an area free of loose or powdery snow so that visibility will not be restricted by blowing snow.

(2) Accomplish a landing to the ground. Limited visibility will result from swirling snow, when hovering is attempted before making touchdown.

(3) Anticipate loose powdery snow and crusts on all landings on snow.

(4) During landing the reference point should be kept forward and to the right so that it will be visible to the pilot at all times.

8-64. Desert and Hot Weather Operation.

Problems encountered in desert operation are blowing dust/sand and high ambient temperature.

a. Blowing dust and sand obscure vision. All takeoffs and landings should be made from or to the ground.

b. High ambient temperature affect helicopters performance. Refer to Chapter 7.

8-65. Turbulence.

a. Intentional flight into known or forecast severe or extreme turbulence is prohibited.

b. Intentional flight into known or forecast moderate turbulence is prohibited when the report or forecast is based on transport type aircraft.

c. Intentional flight into known or forecast moderate turbulence is permitted when the report or forecast is based on helicopters or light airplanes under 12,500 pounds gross weight.

d. To minimize the affects of moderate turbulence encountered in flight the helicopter should be flown at an airspeed corresponding to minimum torque required; maximum endurance airspeed. There will be a corresponding increase in control movements at the reduced airspeed.

e. Helicopter controlability is the primary consideration; therefore, if control becomes marginal, exit the turbulence as soon as possible.

f. In turbulence, check that all occupants are seated with seat belts and harnesses tightened.

8-65.1 Thunderstorms.

a. Intentional flight into thunderstorms is prohibited. To minimize the effects of thunderstorms encountered in flight, perform the following:

(1) Adjust torque to maintain maximum endurance airspeed.

(2) Check that all occupants are seated with seat belts and harnesses tightened.

(3) PITOT HTR switch ON.

(4) Avionics — Reduce volume on any equipment affected by static.

(5) Interior lights — Adjust to full bright at night to minimize blinding effect of lighting.

b. In the storm.

(1) Maintain a level attitude and constant power setting. Airspeed fluctuations should be expected and disregarded.

(2) Maintain original heading, turning only when necessary.

(3) The altimeter is unreliable due to differential barometric pressures within the storm. An indicated gain or loss of several hundred feet is not uncommon and should be allowed for in determining minimum safe altitude.

8-65.2 Lightning Strikes.

a. Although the possibility of a lightning strike is remote, the helicopter could inadvertently be exposed to lightning damage. Therefore, static tests have been conducted to determine lightning strike effects on rotors.

b. Simulated lightning tests indicate that lightning strikes may damage helicopter rotors. The degree of damage will depend on the magnitude of the charge and the point of contact. Catastrophic structural failure is not anticipated. However, lightning damage to hub bearings, blade aft section, trim tabs, and blade tips was demonstrated.

Also, adhesive bond separations occurred between the blade spar and aft section between the spar and leading edge abrasion strip. Some portions of blade aft sections deformed to the extent that partial or complete separation of the damaged section could be expected. Such damage can aerodynamically produce severe structural vibration and serious control problems which, if prolonged, could endanger the helicopter and crew.

WARNING

Avoid flight in or near the thunderstorms especially in areas of observed or anticipated lightning discharges.

NOTE

Abnormal operating noises almost always accompany rotor damage, but loudness or pitch are not valid indications of the degree of damage sustained.

c. If lightning strike occurs, or is expected, the following precautions are recommended to minimize further risk.

(1) Reduce airspeed as much as practical to maintain safe flight.

(2) Avoid abrupt control inputs.

(3) Record suspected lightning strike on DA Form 2408-13. Aircraft must be checked by maintenance personnel prior to resumption of flight.

8-66. Icing Conditions.

a. Intentional flight in any known icing condition is prohibited. If icing conditions are encountered during flight every effort should be made to vacate the icing environment.

b. If icing conditions become unavoidable the pilot should turn on the pitot heat, windshield defroster and the engine anti-ice system.

c. During flights in icing the following condition may be experienced.

(1) Observed forward field of view due to ice accumulation on the windscreens and chin bubbles.

(2) One-per-rotor-revolution vibrations ranging from mild to severe caused by asymmetrical ice shedding from the main rotor system. The severity of the vibration will depend upon the temperatures and the amount of ice accumulation on the blades when the ice shed occurs. The possibility of an asymmetric ice shed occurring increases as the outside air temperature decreases.

(3) An increase in torque required to maintain a constant airspeed and altitude due to ice accumulation on the rotor system.

(4) Possible degradation of the ability to maintain autorotational rotor speed within operating limits. If a 9% (or greater) torque pressure increase is required above the cruise torque setting used prior to entering icing conditions, it may not be possible to maintain autorotational rotor speed within operational limits, should an engine failure occur.

NOTE

If the windshield defrosters fail to keep the windshield clear of ice, the side windows may be used for visual reference during landing.

d. Control activity cannot be depended upon to remove ice from the main rotor system. Vigorous control movements should not be made in an attempt to reduce low-frequency vibrations caused by asymmetrical shedding of ice from the main rotor blades. These movements may induce a more asymmetrical shedding of ice, further aggravating helicopter vibration levels.

WARNING

Ice shed from the rotor blades and/or other rotating components presents a hazard to personnel during landing and shutdown. Ground personnel should remain well clear of the helicopter during landing and shutdown and passengers/crewmembers should not exit the aircraft until the rotor has stopped turning.

Section VI. CREW DUTIES

8-67. Passenger Briefing.

The following is a guide that should be used in accomplishing required passenger briefings, when a unit passenger briefing is not available. Items that do not pertain to a specific mission may be omitted.

a. Crew Introduction.

b. Equipment .

- (1) Personal to include ID tags.
- (2) Professional.
- (3) Survival.

c. Flight Data.

- (1) Route.
- (2) Altitude.
- (3) Time en route.
- (4) Weather.

d. Normal Procedures.

- (1) Entry and exit of aircraft.

WARNING

Demonstrate to passenger how and where loose carry on equipment will be secured. Demonstrate to passenger how seat belts and shoulder harnesses are to be used, and how they are to be secured when exiting.

- (2) Seating.
 - (3) Seat belts.
 - (4) Movement in aircraft.
 - (5) Internal communications.
 - (6) Security of equipment.
 - (7) Smoking.
 - (8) Oxygen.
 - (9) Refueling.
 - (10) Weapons.
 - (11) Protective masks.
 - (12) Parachutes.
 - (13) Aviation Life Support Equipment (ALSE)
- #### *e. Emergency Procedures.*
- (1) Emergency exits.
 - (2) Emergency equipment.
 - (3) Emergency landing/ditching procedures.
 - (4) Bail out.

CHAPTER 9

EMERGENCY PROCEDURES

Section I. HELICOPTER SYSTEMS

9-1. Helicopter Systems.

This section describes the helicopter systems emergencies that may reasonably be expected to occur and presents the procedures to be followed. Emergency procedures are given in checklist form when applicable. A condensed version of these procedures is contained in the Operators and Crewmembers Checklist, TM 55-1520-235-CL. Emergency operations of avionics equipment are covered when appropriate in Chapter 3, Avionics.

9-2. Immediate Action Emergency Checks.

checks that shall be performed immediately in an emergency procedure are underlined. These immediate action emergency checks shall be committed to memory.

NOTE

The urgency of certain emergencies requires immediate and instinctive action by the pilot. The most important single consideration is helicopter control. All procedures are subordinate to this requirement. Reset master caution after each malfunction in order to prepare the system for subsequent malfunctions. If time permits during the emergency, make a "MAYDAY TRANSMISSION".

9-3. Definition of Landing Terms.

For the purposes of standardization the following definitions shall be included:

The term *LAND AS SOON AS POSSIBLE* is defined as executing a landing to the nearest suitable landing area (e.g., open field) without delay. The primary consideration is to assure the survival of occupants.

The term *LAND AS SOON AS PRACTICABLE* is defined as executing a landing to the nearest suitable airfield/heliport."

9-4. After Emergency Action.

After a malfunction of equipment has occurred, appropriate emergency actions have been taken and the helicopter is on the ground, an entry shall be made in the Remarks Section of DA Form 2408-13 describing the malfunction. Ground and flight operations shall be discontinued until corrective action has been taken.

9-5. Emergency Entrance.

To gain entrance to the cabin in the event of an emergency, first attempt to open doors. If doors will not open, break windows and activate emergency jettison handle. The cockpit doors can be jettisoned by pulling the yellow handles to the Aft position and the cabin doors by pushing the yellow handles to fwd position (figure 9-1). If doors will not jettison, break windshield to gain entrance.

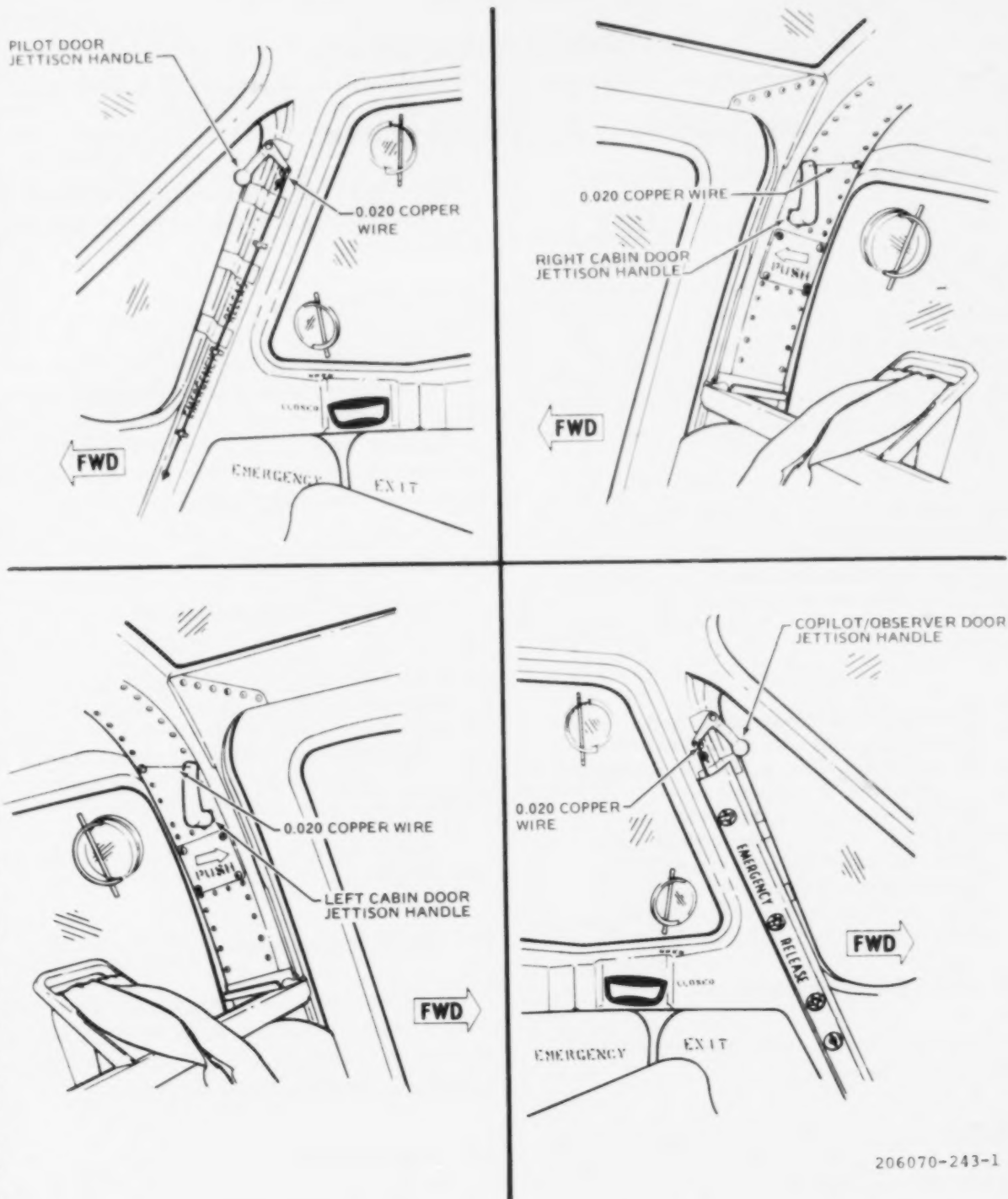
9-6. Engine.

9-7. Flight Characteristics.

The characteristics and reactions in this helicopter without power are similar to those of a normal power descent. Full control can be maintained with the helicopter in autorotational descent.

9-8. Engine Failure.

The indications of an engine failure, either a partial power loss or a complete power loss are:



206070-243-1

Figure 9-1. Emergency exits and equipment (Sheet 1 of 2)



206070-243-2

Figure 9-1. Emergency exits and equipment (Sheet 2 of 2)

- a. A left yaw. This is caused by the drop in torque applied to the main rotor.
- b. A drop in engine RPM.
- c. A drop in rotor RPM.
- d. A low RPM audio alarm.
- e. Illumination of the ROTOR RPM light.
- f. A change in engine noise.
- g. Illumination of the ENG OUT warning light.

WARNING

DO NOT CLOSE THE THROTTLE. Do not respond to the rpm audio and/or warning light illumination without first confirming engine failure by one or more of the other indications. Normal indications signify that the engine is functioning properly and that there is a tachometer generator failure or and open circuit to the warning system rather than an actual engine failure.

Under partial power conditions, the engine may operate relatively smoothly at reduced power or it may operate roughly and erratically with intermittent surges of power. In instances where a power loss is experienced without accompanying engine roughness or surging, the helicopter may sometimes be flown at reduced power to a favorable landing area; however, under these conditions the pilot should always be prepared for a complete power failure. In the event that a partial power condition is accompanied by engine roughness, erratic operation or power surging, close the throttle completely and perform an autorotational descent and landing.

Procedures to be followed after an engine failure are governed by the altitude and airspeed available to establish an autorotational glide, control the helicopter and maintain sufficient rotor rpm for successful landing.

The position of the collective pitch after engine failure will vary with altitude and airspeed at the time of the occurrence. For example, collective pitch must not be decreased when an engine failure occurs at a hover-in-ground effect; whereas, during cruise flight conditions altitude and airspeed are sufficient for a significant reduction in collective pitch, thereby allowing rotor speed to be maintained in the safe operating range during autorotational descent. Should the engine fail during a left bank maneuver, right cyclic input to level the aircraft must be made simultaneously with collective pitch adjustment. If the collective pitch is de-

creased without a corresponding right cyclic input, the helicopter will pitch down and the left roll rate will increase rapidly resulting in a significant loss of altitude.

Cyclic control is adjusted as necessary to remain over the desired point after engine failure at a hover or to control airspeed and flight path after engine failure occurs in forward flight.

Pedal pressure is applied as necessary to control trim and varies with airspeed and the amount of collective pitch applied at the time of engine failure.

Airspeed should be maintained at the optimum if conditions permit. As airspeed increases above 43 KIAS, there is a corresponding increase in rate of descent. Airspeed up to 71 KIAS will increase glide distance but should be avoided at low altitude because of the time available to decelerate is critical. At airspeeds below 43 KIAS, rate of descent increases and glide distance decreases. Gliding the helicopter in autorotation out-of-trim will also increase rate of descent and decrease glide distance; therefore, pedal control immediately after engine failure and during descent is important. If time permits during the autorotational descent transmit a "May Day" call, set transponder to the appropriate emergency mode and code and lock shoulder harness.

9-9. Minimum Rate of Descent — Power Off.

The power off minimum rate of descent is attained at an indicated airspeed of approximately 43 knots and 100% rotor rpm. Refer to figure 9-2, minimum rate of descent.

9-10. Maximum Glide Distance — Power Off.

The maximum glide distance is attained at an indicated airspeed of approximately 71 knots and 100% rotor rpm. Refer to figure 9-2, MAXIMUM GLIDE DISTANCE.

9-11. ENGINE FAILURE — LOW ALTITUDE/LOW AIRSPEED.

When an engine failure occurs at low altitude and low airspeed (the avoid area of the Height Velocity Diagram, figure 5-4), sufficient altitude is not available to increase rotor rpm, establish the best autorotational airspeed and decelerate effectively prior to touchdown. Initial collective pitch reduction will vary from no reduction at zero airspeed below 15 feet to completely down at higher airspeeds and altitude. Intermediate airspeeds and altitudes require a partial reduction in collective pitch in order to reach the termination point without excessive rotor speed decay. If the airspeed is less than 43 KIAS and altitude permits,

GLIDE DISTANCE

100% ROTOR RPM

GLIDE
OH-58C
T63-A-720

EXAMPLE

WANTED

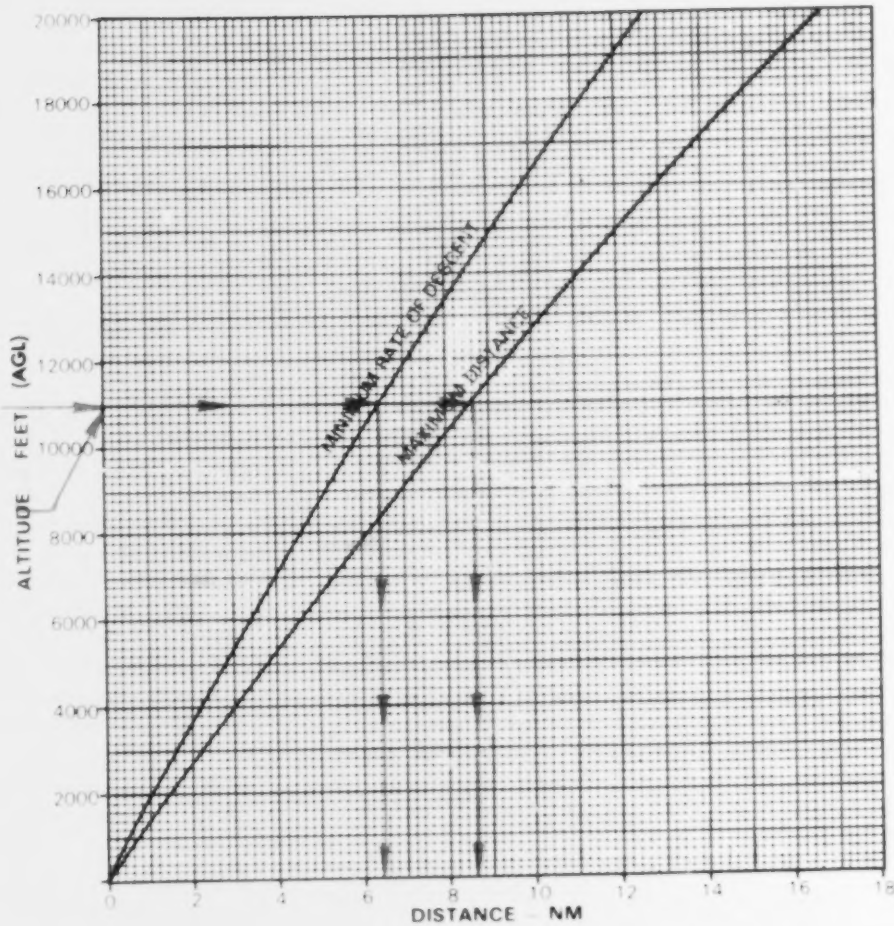
MINIMUM RATE OF DESCENT
AND MAXIMUM GLIDE DISTANCE

KNOWN

ALTITUDE - 11000 FEET

METHOD

ENTER ALTITUDE HERE
MOVE RIGHT TO MINIMUM RATE OF DESCENT
MOVE DOWN, READ DISTANCE
FROM MINIMUM RATE OF DESCENT
ENTER ALTITUDE HERE
MOVE RIGHT TO MAXIMUM
DISTANCE LINE
MOVE DOWN, READ MAXIMUM
GLIDE DISTANCE - 8.6 NM



DATA BASIS: DERIVED FROM FLIGHT TEST OF SIMILAR TYPE AIRCRAFT

Figure 9-2. Glide distance

apply forward cyclic as necessary to increase airspeed to approximately 43 KIAS. Touchdown should be made in a level attitude after ground speed has been reduced as much as possible.

When engine failure occurs proceed as follows:

1. Collective pitch — Adjust as necessary; establish autorotational glide.
2. Land.
3. Fuel Valve handle - OFF.
4. BAT switch — OFF.

9-12. ENGINE FAILURE - TAKEOFF.

Refer to ENGINE FAILURE — LOW ALTITUDE.

9-13. ENGINE FAILURE — CRUISE.

In cruise flight at airspeeds up to V_{ne} reduce collective pitch immediately to the full down position in order to regain the rotor rpm, and apply right pedal pressure to trim helicopter. Adjust cyclic pressure as necessary to attain and maintain the required airspeed. A landing area shall be selected as soon as the engine failure is recognized and control movements made as necessary to fly to the intended site. Throughout the descent adjust collective pitch as necessary to maintain the rotor rpm in the normal operating range. At high gross weights during turns the rotor may tend to overspeed and require collective pitch application to maintain the rpm below the upper limit. Collective pitch should never be applied to reduce rpm for extending glide distance because of the reduction in rpm available for use during touchdown. Touchdown speed should be adjusted as necessary depending on touchdown area. When engine failure occurs, proceed as follows:

1. Collective pitch - Down: establish autorotational glide.
2. Land.
3. Fuel Valve handle - OFF. If time permits during descent, the FUEL ON/OFF control handle should be turned OFF prior to touchdown to reduce the possibility of fire.
4. BAT switch — OFF.

9-14. ENGINE RESTART — DURING FLIGHT.

After an engine failure in flight, and the engine does not relight automatically an engine restart may be attempted. Because the exact cause of engine failure cannot be determined in flight, the decision to attempt the start will depend on the altitude and time available, rate of descent, potential landing areas, and crew assistance available. Under ideal conditions approximately one minute is required to regain powered flight from the time the attempted start is begun. If the decision is made to attempt an in-flight start, proceed as follows:

1. Throttle — Closed.
2. Attempt start.
 - a. Starter switch — Press.
 - b. Throttle — Full open as N1 passes through 12 percent.
 - c. Starter switch — Release as N1 reaches 58-62 percent.
3. Land as soon as possible — After the engine is started and powered flight is reestablished, perform a power on approach and landing without delay.

9-15. ENGINE OIL - LOW PRESSURE, HIGH PRESSURE, HIGH TEMPERATURE, ENG OIL BYPASS CAUTION LIGHT ILLUMINATION.

a. If engine oil pressure is below 50 PSI, temperature increases above 107°C or engine OIL BYPASS light illuminates, land as soon as possible.

b. If engine oil pressure is within the range of 50 to 90 PSI with 79% to 89% N1, land as soon as practicable.

c. If engine oil pressure is within the range of 50 to 114 PSI with 90% N1 and above, land as soon as practicable.

d. If engine oil pressure is above 130 PSI, land as soon as practicable.

9-16. ENG CHIP DET Caution Light Illumination.

If the ENG CHIP DET caution light illuminates, land as soon as possible.

9-17. MAIN DRIVE SHAFT FAILURE.

A failure of the main drive shaft will be indicated by a sudden increase in engine rpm, decrease in rotor rpm, left yaw and activation of the low rpm audio. A transient overspeed of N1, N2, and tail rotor may occur but will stabilize. N1 should stabilize between 65 and 75 percent and N2 stabilize from 98 to 101 percent. In the event of main drive shaft failure, proceed as follows:

1. Collective pitch — Down; establish autorotational glide.
2. Throttle — Open or adjust as required to maintain engine rpm at or below the maximum operating limit. The engine must continue to operate in order to provide tail rotor control.
3. Land. Accomplish an autorotational descent and landing.
4. Throttle — closed.
5. BAT switch — OFF.

9-17.1. CLUTCH FAILS TO DISENGAGE.

A clutch failing to disengage in flight will be indicated by the rotor rpm decaying with engine rpm as the throttle is reduced to the engine idle position when entering autorotational descent. This condition results in total loss of autorotational capability; therefore, the throttle must be returned to the full open position immediately. If a failure occurs, do the following:

1. Throttle — Full open.
2. Land as soon as possible.

9-18. ENGINE OVERSPEED.

If an engine overspeed is experienced, proceed as follows:

1. Collective pitch — Increase to load the rotor and sustain engine rpm below the maximum operating limit.

2. Throttle — Reduce until normal operating rpm is attained.

3. Land as soon as possible.

If rpm cannot be controlled manually, proceed as follows:

4. Throttle — Closed when over a safe landing area.
5. Collective pitch — Down; establish autorotational glide.
6. Land — Accomplish an autorotational descent and landing.
7. Fuel Valve handle — OFF. If time permits during descent the FUEL ON/OFF control handle should be turned OFF prior to touchdown to reduce the possibility of fire.
8. BAT switch — OFF.

9-19. ENGINE UNDERSPEED.

a. N2 RPM 94% to 98%. If engine underspeed is experienced, land as soon as possible at an area that will permit a run-on landing.

b. N2 RPM — below 93%. If an engine underspeed is experienced proceed as follows:

1. Collective pitch — Down; establish autorotational glide.
2. Throttle — Closed.
3. Land — Accomplish an autorotational descent and landing.
4. Fuel Valve handle — OFF. If time permits during descent the FUEL ON/OFF control handle should be turned OFF prior to touchdown to reduce the possibility of fire.
5. BAT switch — OFF.

9-20. ENGINE SURGES.

If surges in engine rpm are experienced, proceed as follows:

1. GOV INCR switch — INCR for maximum rpm.
2. Throttle — Reduce to 98% N2.
3. Land as soon as possible.

If engine surges are not controlled in steps 1 and 2 above proceed as follows:

4. Collective pitch — Down, establish autorotational glide.
5. Throttle — Closed.
6. Land — Accomplish an autorotational descent and landing.
7. Fuel Valve handle - OFF. If time permits during descent the FUEL ON/OFF control handle should be turned OFF prior to touchdown to reduce the possibility of fire possibility of fire.
8. BAT switch — OFF.

9-21. ENGINE COMPRESSOR STALL.

Engine compressor stall (surge) is characterized by a sharp rumble or a series of loud sharp reports, severe engine vibration and a rapid rise in TOT depending on the severity of the surge. Maneuvers requiring rapid or maximum power applications should be avoided. Should this occur, the following steps should be accomplished.

1. Collective pitch — Reduce.
2. ENG DEICE Switch — OFF.
3. HTR Switch — OFF.
4. Land as soon as possible.

9-22. ROTORS, TRANSMISSION, AND DRIVE SYSTEMS.

9-23. TAIL ROTOR MALFUNCTIONS.

Because of the many different malfunctions that can occur it is not possible to provide a solution for every emergency. The success in coping with the emergency depends on quick analysis of the condition and selection of the proper emergency procedure. The following is a discussion of some types of malfunctions, probable effects, and corrective actions.

a. Complete Loss of Tail Rotor Thrust. This is a situation involving a break in the drive system such as severed drive shaft, wherein the tail rotor stops turning, and no thrust whatsoever is delivered by the tail rotor. A failure of this type will always result in the nose of the helicopter turning to the right (left sideslip) and a left roll of the fuselage along the horizontal axis. It is likely that powered flight to a suitable area and execution of an autorotative approach is the proper emergency procedure.

(1) In powered flight, the degree of sideslip and the degree of roll may be varied by changing airspeed and by varying power (throttle or pitch), but neither can be eliminated. Below an airspeed of approximately 30 to 40 knots, the sideslip angle may become uncontrollable, and the helicopter may continue to yaw.

(2) In power-off flight (autorotation), the sideslip angle and the roll angle can be almost completely eliminated by maintaining an airspeed of 40 to 70 knots. When airspeed is decreased below 40 knots, directional stability from the vertical fin is greatly reduced and the sideslip angle may become uncontrollable. Upon pitch application at touchdown, the nose will tend to turn to the left due to an increase of friction in the rotor drive system.

b. Fixed Pitch Setting. This is a malfunction involving a loss of control resulting in a fixed pitch setting. Normally under these circumstances the directional pitch setting that is in the tail rotor at the time of failure will remain in the tail rotor system. Whether the nose of helicopter yaws left or right is dependent upon the amount of pedal (which is related to speed and power) applied at the time the failure occurs. Regardless of pedal setting at the time of malfunction, tail rotor thrust will vary as a function of sideslip angle and speed.

an increase in power at touchdown will result in a left sideslip if powered approach is used, although this sideslip should not be of a severe magnitude for touchdown.

c. Loss of Tail Rotor or Components, Thereof
The severity of this situation is dependent upon the amount of weight lost. If the loss is small, such as "aft of the 90 degree gear box", the situation should be quite similar to "complete loss of tail rotor thrust." If additional components are lost, immediate autorotation may be the only practical solution. Any loss of this nature will result in a forward center of gravity shift, requiring longitudinal control compensation in conjunction with autorotation to maintain a safe pitch attitude.

9-24. Emergency Procedures — In Flight.

When an antitorque malfunction occurs, attempt to regain helicopter control in cruise flight. If the situation permits, a change in collective pitch (power) may be attempted as an aid in gaining maximum possible control (trim) of the helicopter under existing circumstances. An increase in collective pitch turns the nose right; decrease turns it left. Rolling off power (throttle) will turn the nose left. The courses of action available will normally be:

a. An autorotational descent and landing should be accomplished where possible under most circumstances, except as described in paragraph *c.* below. The autorotative technique to be used is described in paragraph *b.* below.

b. If vibration is not excessive and a safe landing area is not immediately available, continue powered flight to a suitable landing area with an airspeed dictated by the limitations of the emergency condition. This airspeed should be that which is most comfortable to the pilot (between 40 and 70 knots) indicated. When the landing area is reached, lower the collective pitch, close the throttle and make a full autorotative landing. During the descent, an airspeed above minimum rate of descent airspeed should be maintained and turns kept to an absolute minimum. If turns must be made during autorotational descent, right turns are preferred if possible. If the landing area is a level, paved surface, a run-on landing with a touchdown airspeed between 15 and 25 knots should be accomplished. If the field is unprepared, start to decelerate from about 75 feet altitude, so that forward groundspeed is at a minimum when the helicopter reaches 10 to 20 feet; execute the touchdown with a rapid collective pull just prior to touchdown in a level attitude with minimum ground slide (zero, if possible).

c. If the tail rotor pitch is fixed in a "left pedal applied" position (tail rotor delivering thrust to the left) autorotative, landing must not be attempted. The pilot should return to powered level flight at a comfortable airspeed which will be dictated by the degree of sideslip and roll; continue powered flight to the nearest improved landing area, and execute a run-on landing with power and a touchdown speed which will minimize sideslip. Prior to final approach the throttle may be reduced to maintain engine rpm at 98% manually. Upon decreasing power to initiate the approach to the landing area, the sideslip angle will increase and a considerable amount of right cyclic will be required for the duration of the approach at this speed. This condition should be corrected when touchdown power is applied.

9-24.1 Inflight Wire Strikes.

Immediately prior to and during cable impact, deflection and cutting:

1. Maintain straight and level flight. If in other than level flight (climb, descent, turn) and time does not permit correction to level flight, maintain steady maneuver.
2. Maintain airspeed.
3. Do not initiate any violent maneuvers.
4. On clearing the wire strike area the helicopter should be landed as soon as possible and inspected for damage, particularly in the main rotor control tube area.

9-24.2 Lower WSPS Ground Contact.

If ground contact is experienced, land helicopter as soon as practicable. After landing lower WSPS for damage and security.

NOTE

Loss of Breakaway Tip is not cause for grounding of aircraft. However, it should be replaced as soon as practical.

9-25. Emergency Procedures — Hover.

- a.** If the tail rotor pitch is fixed in a "left pedal applied" position, gradually decrease collective pitch and land the helicopter.
- b.** If total loss of tail rotor thrust is experienced, close the throttle immediately and accomplish an autorotational landing.

9-25.1 Loss of Tail Rotor Effectiveness (LTE).

- a.** If LTE is experienced, simultaneously:

- (1) PEDAL — FULL LEFT.

(2) CYCLIC — FORWARD.

(3) As recovery is effected, adjust controls for normal flight.

WARNING

Collective reduction will aid in arresting the yaw rate; however, if a vertical rate of descent has been established, collective reduction may increase the rate of descent to an excessive value. The resultant large and rapid increase in collective to prevent ground or obstacle contact may further increase the yaw rate, decrease the rotor RPM and cause an overtorque and/or overtemp condition. Therefore, the decision to reduce collective must be based on the pilot's assessment of the altitude available for recovery.

b. If spin cannot be stopped and crash is imminent, an autorotation may be the best course of action. Maintain full left pedal until the spin stops, then adjust to maintain heading.

9-26. XMSN OIL HOT, XMSN OIL PRESS Warning Light Illumination, or XMSN OIL PRESS LOW.

If the XMSN OIL HOT OR XMSN OIL PRESS warning light illuminates or transmission oil pressure drops below 30 PSI.

Land as soon as possible.

9-27. XMSN CHIP DET OR T/R CHIP DET CAUTION LIGHT ILLUMINATION.

If the XMSN CHIP DET caution light or the T/R CHIP DET caution light illuminates.

Land as soon as possible.

9-28. MAST BUMPING.

Land as soon as possible.

9-29. FIRE.

The safety of helicopter occupants is the primary consideration when a fire occurs; therefore, it is imperative that every effort be made by the flight crew to put the fire out. On the ground it is essential that the engine be shut down, crew and passengers evacuated and fire fighting begun immediately. If time permits a "MAYDAY" radio call should be made before the electrical power is OFF to expedite assistance from air-

field fire fighting equipment and personnel. If the helicopter is airborne when a fire occurs the most important single action that can be taken by the pilot is to land the helicopter.

WARNING

Use fire extinguishers only in well ventilated areas because the toxic fumes of the extinguishing agent may cause injury.

9-30. ENGINE FIRE.

9-31. HOT START — EMERGENCY SHUTDOWN.

The following procedure is applicable during engine starting or shut down if flames are emitted from the exhausts, TOT limits shown in figure 5-1 are exceeded, or it becomes apparent that it will be exceeded.

1. Starter switch — Press. The starter switch shall be held until TOT is below 200°C.
2. Throttle — Closed. The throttle must be closed immediately as the starter switch is pressed.
3. Fuel Valve handle - OFF.
4. FUEL boost switch - OFF. If time permits, the fuel boost switch should be turned off to reduce the possibility of fire.

9-32. FUSELAGE FIRE — GROUND.

If fire is observed in any part of the helicopter during ground operations proceed as follows:

1. Throttle — Closed.
2. Fuel Valve handle - OFF.
3. BAT switch — OFF.

4. FUEL boost switch - OFF. If time permits, the fuel boost switch should be turned off to reduce the possibility of fire.

5. Clear the helicopter of all passengers and crew immediately.

9-33. FUSELAGE FIRE — FLIGHT.

If fire is observed in any part of the helicopter during flight, proceed as follows:

1. Land as soon as possible — Perform a power-on approach and landing without delay.
2. Throttle — Closed after landing.
3. Fuel valve handle - OFF.
4. BAT switch — OFF.
5. Deleted.
6. Clear the helicopter of all passengers and crew immediately.

determine whether to execute a powered approach or a power off autorotational descent to the ground. If fire is observed in or around the engine during cruise flight and the pilot decides to execute a power off descent, proceed as follows:

1. Collective pitch — Down; autorotate.
2. Throttle — Closed.
3. Fuel Valve handle - OFF.
4. Land.
5. BAT switch — OFF.
6. Deleted.

9-36. CRUISE ALTITUDE.

Prevailing circumstances, such as altitude and landing areas available must be considered in order to

7. Clear the helicopter of all passengers and crew immediately.

9-37. ELECTRICAL FIRE.**9-38. ELECTRICAL FIRE — FLIGHT.**

In the event of electrical fire or suspected electrical fire in flight to include avionics, battery and other electrical components, proceed as follows:

1. GEN switch - OFF.
2. BAT switch - OFF.
3. Land as soon as possible.
4. Throttle — Closed after landing.
5. Fuel Valve handle - OFF.
6. FUEL boost switch - OFF. If time permits, the fuel boost switch should be turned off to reduce the possibility of fire.
7. Clear the helicopter of passengers and crew immediately.

9-39. ELECTRICAL FIRE — FLIGHT CONTINUED.

If landing cannot be made immediately and flight must be continued, the defective circuits may be identified and isolated as follows:

1. Complete steps 1 and 2 above.
2. Circuit breakers — Out.

As each of the following steps is accomplished, check for indications of the source of the fire, e.g. smoke and fumes or high amperage.

3. GEN switch — GEN.
4. BAT switch — BAT.
5. Circuit breakers — In one at a time in the priority required. When malfunctioning circuit is identified, pull the circuit breaker or turn the switch off to the applicable circuit.

9-40. ELECTRICAL FIRE — GROUND.

In the event of electrical fire or suspected electrical fire during ground operations, proceed as follows:

1. Throttle — Closed.
2. Fuel Valve handle - OFF.
3. GEN switch — OFF.
4. BAT switch — OFF.
5. FUEL boost switch - OFF. If time permits, the fuel boost switch should be turned off to reduce the possibility of fire.
6. Clear the helicopter of passengers and crew immediately.

9-40.1 BATTERY OVERHEAT - GROUND

Deleted.

9-41. SMOKE AND FUME ELIMINATION.

Smoke and/or toxic fumes entering the cockpit and cabin can be exhausted as follows:

1. Vents — Open.
2. DEFOG & VENT switch — ON.

CAUTION

Do not jettison doors.

9-42. FUEL SYSTEM.**9-43. FUEL BOOST FAILURE/CAUTION LIGHT ILLUMINATION.**

Land as soon as possible.

9-44. FUEL FILTER CAUTION LIGHT ILLUMINATION.

If the FUEL FILTER caution light illuminates, and remains illuminated, land as soon as possible.

9-45. ELECTRICAL SYSTEM.

9-46. GENERATOR MALFUNCTION - No output.

A no output malfunction of the generator will be indicated by a zero indication on the DC AMMETER and a DC GENERATOR caution light illumination. An attempt may be made to put the generator back on line by accomplishing the following:

1. GEN FIELD circuit breaker — out then in.
2. GEN and BUS RESET circuit breaker — out then in.
3. GEN Switch - RESET then GEN. If the main generator is not reclaimed, or if it goes off the line again.
4. GEN Switch - OFF.
5. Turn OFF all unnecessary electrical equipment.
6. Land as soon as practicable.

9-46.1 GENERATOR MALFUNCTION - HIGH OUTPUT.

WARNING

If battery overheats or emits noxious fumes, do not open battery compartment until battery is cool. Injury or serious burns could occur if an overheated battery explodes and exposes personnel to the potassium hydroxide (KOH) electrolyte.

An abnormally high DC AMMETER indication is evidence of a short circuit or a high battery charging rate or a battery thermal runaway. High battery charging amperage is normal immediately after engine start and should dissipate to approximately 5 AMPS or less within minutes. DC AMMETER indication of 65 AMPS or below is normal after 15 minutes of aircraft operation with all systems operating.

If high DC amperage does not gradually dissipate:

1. BAT Switch - OFF.

If high DC amperage indication disappears with BAT Switch OFF a high battery charging rate and possible battery thermal runaway is confirmed, in this event:

2. Land as soon as possible.

If high DC amperage indication does not disappear with BAT Switch OFF:

3. Perform Paragraph 9-38 sequences.

9-47. SPARE CAUTION LIGHT ILLUMINATION.

If a SPARE caution light illuminates, land as soon as possible.

9-47.1 GPU FAILURE DURING START.

A GPU failure during engine starting will be indicated by a complete failure of the aircraft electrical system, and could possibly result in an engine overtemp. To prevent an excessive TOT and to monitor the engine instruments, accomplish the following:

1. Throttle - Closed. The throttle switch must be closed immediately.
2. BAT Switch - ON.
3. Starter Switch - Press. The starter switch shall be held until the TOT is below 200° degrees C.

9-48. HYDRAULIC.

9-48.1. HYDRAULIC PRESSURE CAUTION LIGHT ILLUMINATES WITH NO CONTROL FEEDBACK.

Failure of parts such as the hydraulic pressure switch can cause the HYD PRESS caution light to illuminate without the presence of control feedback. In this event proceed as follows:

Land as soon as practicable at an area that will permit a run-on landing approximately 5 knots ground speed.

9-49. HYDRAULIC POWER FAILURE.

Hydraulic power failure will be evident when the force required for control movement increases; a moderate feedback in the cyclic and collective controls is felt and the HYD PRESS caution light illuminates. Control movements will result in normal aircraft response in every respect. In the event of hydraulic power failure, proceed as follows:

1. Airspeed — Adjust as necessary to attain the most comfortable level of control movements.
2. HYD BOOST SOL circuit breaker — Out; check for restoration of hydraulic power.

3. HYD BOOST SOL circuit breaker — IN, if hydraulic power is not restored.
4. HYD BOOST switch — OFF.

WARNING

Do not return the HYD BOOST switch to the HYD BOOST position for the remainder of the flight. This prevents any possibility of a surge in hydraulic pressure and the resulting control variations.

5. Land as soon as practicable at an area that will permit a run-on landing (approximately 5 knots ground speed) with prower.

9-50. LANDING AND DITCHING.

9-51. Landing in Trees.

A landing in trees should be made only when no other landing area is available. In addition to accomplishing engine failure emergency procedures, select a landing area containing the least number of trees of minimum height. Decelerate to zero ground speed at tree-top level and descent into the tree vertically increasing collective pitch as necessary for minimum rate of descent. Prior to the main rotor blades entering the trees, apply all of the remaining collective pitch.

9-52. DITCHING — POWER ON.

If it becomes necessary to ditch the helicopter, accomplish an approach to an approximate 3-foot hover above the water and proceed as follows:

1. Doors — Jettison.
2. Crew (except pilot) and passengers — Exit.
3. Hover a safe distance away from personnel.
4. Throttle — Close and execute an autorotation into the water. Apply full collective pitch prior to the main rotor blades entering the water. Maintain a level attitude as the helicopter sinks and until it begins to roll, then apply cyclic in direction of the roll.
5. Pilot — Exit when the main rotor is stopped.

9-53. DITCHING — POWER OFF.

If an engine failure occurs over water and ditching is imminent, accomplish engine failure emergency procedures and proceed as follows:

1. Doors — Jettison.
2. Land. Accomplish autorotational descent, decelerating to zero forward speed as the helicopter nears the water. Apply all of the collective pitch as the helicopter enters the water. Maintain a level attitude as the helicopter sinks and until it begins to roll, then apply cyclic in the direction of the roll.
3. Crew and passengers — Exit when the main rotor is stopped.

9-54. FLIGHT CONTROL MALFUNCTIONS.

Failure of components within the flight control system may be indicated through varying degrees of feedback, binding, resistance, or sloppiness. These conditions should not be mistaken for hydraulic power failure. In the event of a flight control malfunction, proceed as follows:

1. Land as soon as possible.
2. Complete an engine shutdown immediately.

9-55. BAIL OUT. Deleted.

9-56. LIGHTNING STRIKE.

Land as soon as possible.

9-56.1 INFLIGHT WIRE STRIKES.

On clearing the wire strike area - Land as soon as possible.

9-56.2. LOWER WSPS GROUND CONTACT.

If ground contact is experienced - Land as soon as possible.

APPENDIX A

REFERENCES

The following references of the issue in effect at the date of this publication are required for use by the operator in performance of his duties.

AR 95-1	Army Aviation General Provisions and Flight Regulations
AR 95-16	Weight and Balance Army Aircraft
AR 95-27	Operational Procedures for Aircraft Carrying Dangerous Materials
AR 310-1	Publications, Blank Forms and Printing Management
AR 310-3	Military Publications, Preparation, Coordination, and Approval
AR 310-25	Dictionary of US Army Terms
AR 310-50	Authorized Abbreviations and Brevity Codes
AR 385-25	Studies and Review, Nuclear Weapons Systems Operational Study Program
AR 385-40	Accident Reporting and Records
DA PAM 310-1	Index of Administrative Publications
TB MED251	Noise and Conservation of Hearing
TB 55-1500-314-25	Handling, Storage and Disposal of Self-Luminous Aircraft Instrument and Markers and Aircraft Engine Ignition Exciter Units Containing Radio Active Material
TB 55-9150-200-25	Engine and Transmission Oils, Fuels and Additives for Army Aircraft
TM 3-220	Chemical, Biological, and Radiological (CBR) Decontamination
TM 38-250	Preparation of Hazardous Materials for Military Air Shipment.
TM 38-750	The Army Maintenance Management System
TM 55-405-9	Army Aviation Maintenance Engineering Manual: Weight and Balance
TM 55-1500-328-25	Aeronautical Equipment Maintenance Management Policies and Procedures
TM 57-220	Technical Training for Parachutists

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This manual is published for the use of all concerned.

By Order of the Secretary of the Army:

BERNARD W. ROGERS
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:

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THEN... JOT DOWN THE DOPE ABOUT IT ON THIS FORM, TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

FROM: (YOUR UNIT'S COMPLETE ADDRESS)

PFC JOHN DOE
COA, 3rd ENGINEER BN
FT. LEONARD WOOD MO 63108

DATE

16 DEC 74

PUBLICATION NUMBER

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DATE

1 APR 72

TITLE

GENERATOR SET 10 KW
NSN 6115-00-231-7286

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IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.
6	2-1 a		
81		4-3	
125	line 20		

In line 6 of paragraph 2-1a the manual states the engine has 6 cylinders. The engine on my set only has 4 cylinders. Change the manual to show 4 cylinders.

Callout B on figure 4-3 is pointing at a bolt. In the key to fig. 4-3, item 16 is called a shim. Please correct one or the other.

I ordered a gasket, item 19 on figure B-16 by NSN 2910-00-762-3001. I got a gasket but it doesn't fit. Supply says I got what I ordered so the NSN is wrong. Please give me a good NSN.

TYPED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

JOHN DOE, PFC (268) 317-7111

SIGN HERE:

John Doe

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TEAR ALONG DOTTED LINE

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
 1 decimeter = 10 centimeters = 3.94 inches
 1 meter = 10 decimeters = 39.37 inches
 1 dekameter = 10 meters = 32.8 feet
 1 hectometer = 10 dekameters = 328.08 feet
 1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
 1 decigram = 10 centigrams = 1.54 grains
 1 gram = 10 decigrams = .035 ounce
 1 dekagram = 10 grams = .35 ounce
 1 hectogram = 10 dekagrams = 3.52 ounces
 1 kilogram = 10 hectograms = 2.2 pounds
 1 quintal = 100 kilograms = 220.46 pounds
 1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
 1 deciliter = 10 centiliters = 3.38 fl. ounces
 1 liter = 10 deciliters = 38.82 fl. ounces
 1 dekaliter = 10 liters = 2.64 gallons
 1 hectoliter = 10 dekaliters = 26.42 gallons
 1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
 1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
 1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
 1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
 1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
 1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
 1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
 1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	To	Multiply by	To change	To	Multiply by
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	3.94
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.365	metric tons	short tons	1.102
pound-inches	newton-meters	.11375			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C
----	------------------------	----------------------------	---------------------	----

